

Exhibit A

United States Bankruptcy Court Southern District of New York Delphi Corporation et al. Claims Processing c/o Kurtzman Carson Consultants LLC, 2335 Alaska Avenue El Segundo, California 90245		Administrative Expense Claim Form		COPY
Debtor against which claim is asserted: Delphi Corporation, et al. 05-44481		Case Name and Number In re Delphi Corporation, et al. 05-44481 Chapter 11, Jointly Administered		
NOTE: This form should not be used to make a claim in connection with a request for payment for goods or services provided to the Debtors prior to the commencement of the case. This Administrative Expense Claim Form is to be used solely in connection with a request for payment of an administrative expense arising after commencement of the case but prior to June 1, 2009, pursuant to 11 U.S.C. § 503.				
Name of Creditor <i>(The person or other entity to whom the debtor owes money or property)</i> Autoliv, ASP, Inc. Name and Address Where Notices Should be Sent c/o Marc N. Swanson Miller Canfield Paddock & Stone PLC 150 West Jefferson Ave., Suite 2500 Detroit, MI 48226 Telephone No. 313.496.7591		Check box if you are aware that anyone else has filed a proof of claim relating to your claim. Attach copy of statement giving particulars. <input type="checkbox"/> Check box if you have never received any notices from the bankruptcy court in this case. <input type="checkbox"/> Check box if the address differs from the address on the envelope sent to you by the court. <input type="checkbox"/>		
ACCOUNT OR OTHER NUMBER BY WHICH CREDITOR IDENTIFIES DEBTOR:		Check here if this claim replaces amends a previously filed claim, dated: ____		
1. BASIS FOR CLAIM Goods sold Services performed Money loaned Personal injury/wrongful death Taxes <input checked="" type="checkbox"/> Other (Describe briefly) Infringement on Patent (see attached)		Retiree benefits as defined in 11 U.S.C. § 1114(a) Wages, salaries, and compensation (Fill out below) Your social security number _____ Unpaid compensation for services performed from _____ (date) to _____ (date)		
2. DATE DEBT WAS INCURRED From petition date and ongoing		3. IF COURT JUDGMENT, DATE OBTAINED:		
4. TOTAL AMOUNT OF ADMINISTRATIVE CLAIM: \$ 1,069,444 Check this box if claim includes interest or other charges in addition to the principal amount of the claim. Attach itemized statement of all additional charges. <input type="checkbox"/>				
5. Brief Description of Claim (attach any additional information): Please see attached.				
6. CREDITS AND SETOFFS: The amount of all payments on this claim has been credited and deducted for the purpose of making this proof of claim. In filing this claim, claimant has deducted all amounts that claimant owes to debtor. 7. SUPPORTING DOCUMENTS: <u>Attach copies of supporting documents</u> , such as promissory notes, purchase orders, invoices, itemized statements of running accounts, contracts, court judgments, or evidence of security interests. DO NOT SEND ORIGINAL DOCUMENTS. If the documents are not available, explain. If the documents are voluminous, attach a summary. Any attachment must be 8-1/2" by 11". 8. DATE-STAMPED COPY: To receive an acknowledgement of the filing of your claim, enclose a stamped, self-addressed envelope and copy of this proof of claim.				THIS SPACE IS FOR COURT USE ONLY <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: 150px;"> RECEIVED JUL 15 2009 </div> KURTZMAN CARSON CONSULTANTS
Date 7/14/2009		Sign and print the name and title, if any, of the creditor or other person authorized to file this claim (attach copy of power of attorney, if any) Marc N. Swanson, Attorney for Autoliv, ASP, Inc.		

Model Code	GM1733	GM1730	GM1737	GM1735	GM1191	GM1192	GM1193	GM1745	TOTAL
Car Brand and Name	Cadillac SRX	Chevy Trailblazer	Chevy Trailblazer XL	Cadillac STS	Chevy Equinox	Pontiac Torrent	Suzuki XL-7	Pontiac Hummer H3	
		Trailblazer GMC Envoy Outasmoelle							
		Browards Island Ascender 3600s							
Estimated price	\$60.00	\$55.00	\$80.00	\$60.00	\$50.00	\$50.00	\$50.00	\$50.00	
Penetration Rates	100%	30%	30%	100%	40%	30%	50%	75%	
Qty of Parts shipped to date (Estimate)	151,004	371,575	28,658	134,535	289,314	83,676	60,386	212,688	
Independent Estimator - @ 150V Curtain	\$120.846	\$297.260	\$32.878	\$107.482	\$20.451	\$75.180	\$44.316	\$78.071	

Source : CSM/2009/AN/PAN	GMT 765	GMT176	GMT177	GMT178	GMT179	GMT180	GMT181	GMT182	GMT183	GMT184	GMT185	GMT186	GMT187	GMT188	GMT189	GMT190	GMT191	GMT192	GMT193	GMT194	GMT195	GMT196	GMT197	GMT198	GMT199	GMT200	GMT201	GMT202	GMT203	GMT204	GMT205	GMT206	GMT207	GMT208	GMT209	GMT210	GMT211	GMT212	GMT213	GMT214	GMT215	GMT216	GMT217	GMT218	GMT219	GMT220	GMT221	GMT222	GMT223	GMT224	GMT225	GMT226	GMT227	GMT228	GMT229	GMT230	GMT231	GMT232	GMT233	GMT234	GMT235	GMT236	GMT237	GMT238	GMT239	GMT240	GMT241	GMT242	GMT243	GMT244	GMT245	GMT246	GMT247	GMT248	GMT249	GMT250	GMT251	GMT252	GMT253	GMT254	GMT255	GMT256	GMT257	GMT258	GMT259	GMT260	GMT261	GMT262	GMT263	GMT264	GMT265	GMT266	GMT267	GMT268	GMT269	GMT270	GMT271	GMT272	GMT273	GMT274	GMT275	GMT276	GMT277	GMT278	GMT279	GMT280	GMT281	GMT282	GMT283	GMT284	GMT285	GMT286	GMT287	GMT288	GMT289	GMT290	GMT291	GMT292	GMT293	GMT294	GMT295	GMT296	GMT297	GMT298	GMT299	GMT300	GMT301	GMT302	GMT303	GMT304	GMT305	GMT306	GMT307	GMT308	GMT309	GMT310	GMT311	GMT312	GMT313	GMT314	GMT315	GMT316	GMT317	GMT318	GMT319	GMT320	GMT321	GMT322	GMT323	GMT324	GMT325	GMT326	GMT327	GMT328	GMT329	GMT330	GMT331	GMT332	GMT333	GMT334	GMT335	GMT336	GMT337	GMT338	GMT339	GMT340	GMT341	GMT342	GMT343	GMT344	GMT345	GMT346	GMT347	GMT348	GMT349	GMT350	GMT351	GMT352	GMT353	GMT354	GMT355	GMT356	GMT357	GMT358	GMT359	GMT360	GMT361	GMT362	GMT363	GMT364	GMT365	GMT366	GMT367	GMT368	GMT369	GMT370	GMT371	GMT372	GMT373	GMT374	GMT375	GMT376	GMT377	GMT378	GMT379	GMT380	GMT381	GMT382	GMT383	GMT384	GMT385	GMT386	GMT387	GMT388	GMT389	GMT390	GMT391	GMT392	GMT393	GMT394	GMT395	GMT396	GMT397	GMT398	GMT399	GMT400	GMT401	GMT402	GMT403	GMT404	GMT405	GMT406	GMT407	GMT408	GMT409	GMT410	GMT411	GMT412	GMT413	GMT414	GMT415	GMT416	GMT417	GMT418	GMT419	GMT420	GMT421	GMT422	GMT423	GMT424	GMT425	GMT426	GMT427	GMT428	GMT429	GMT430	GMT431	GMT432	GMT433	GMT434	GMT435	GMT436	GMT437	GMT438	GMT439	GMT440	GMT441	GMT442	GMT443	GMT444	GMT445	GMT446	GMT447	GMT448	GMT449	GMT450	GMT451	GMT452	GMT453	GMT454	GMT455	GMT456	GMT457	GMT458	GMT459	GMT460	GMT461	GMT462	GMT463	GMT464	GMT465	GMT466	GMT467	GMT468	GMT469	GMT470	GMT471	GMT472	GMT473	GMT474	GMT475	GMT476	GMT477	GMT478	GMT479	GMT480	GMT481	GMT482	GMT483	GMT484	GMT485	GMT486	GMT487	GMT488	GMT489	GMT490	GMT491	GMT492	GMT493	GMT494	GMT495	GMT496	GMT497	GMT498	GMT499	GMT500	GMT501	GMT502	GMT503	GMT504	GMT505	GMT506	GMT507	GMT508	GMT509	GMT510	GMT511	GMT512	GMT513	GMT514	GMT515	GMT516	GMT517	GMT518	GMT519	GMT520	GMT521	GMT522	GMT523	GMT524	GMT525	GMT526	GMT527	GMT528	GMT529	GMT530	GMT531	GMT532	GMT533	GMT534	GMT535	GMT536	GMT537	GMT538	GMT539	GMT540	GMT541	GMT542	GMT543	GMT544	GMT545	GMT546	GMT547	GMT548	GMT549	GMT550	GMT551	GMT552	GMT553	GMT554	GMT555	GMT556	GMT557	GMT558	GMT559	GMT560	GMT561	GMT562	GMT563	GMT564	GMT565	GMT566	GMT567	GMT568	GMT569	GMT570	GMT571	GMT572	GMT573	GMT574	GMT575	GMT576	GMT577	GMT578	GMT579	GMT580	GMT581	GMT582	GMT583	GMT584	GMT585	GMT586	GMT587	GMT588	GMT589	GMT590	GMT591	GMT592	GMT593	GMT594	GMT595	GMT596	GMT597	GMT598	GMT599	GMT600	GMT601	GMT602	GMT603	GMT604	GMT605	GMT606	GMT607	GMT608	GMT609	GMT610	GMT611	GMT612	GMT613	GMT614	GMT615	GMT616	GMT617	GMT618	GMT619	GMT620	GMT621	GMT622	GMT623	GMT624	GMT625	GMT626	GMT627	GMT628	GMT629	GMT630	GMT631	GMT632	GMT633	GMT634	GMT635	GMT636	GMT637	GMT638	GMT639	GMT640	GMT641	GMT642	GMT643	GMT644	GMT645	GMT646	GMT647	GMT648	GMT649	GMT650	GMT651	GMT652	GMT653	GMT654	GMT655	GMT656	GMT657	GMT658	GMT659	GMT660	GMT661	GMT662	GMT663	GMT664	GMT665	GMT666	GMT667	GMT668	GMT669	GMT670	GMT671	GMT672	GMT673	GMT674	GMT675	GMT676	GMT677	GMT678	GMT679	GMT680	GMT681	GMT682	GMT683	GMT684	GMT685	GMT686	GMT687	GMT688	GMT689	GMT690	GMT691	GMT692	GMT693	GMT694	GMT695	GMT696	GMT697	GMT698	GMT699	GMT700	GMT701	GMT702	GMT703	GMT704	GMT705	GMT706	GMT707	GMT708	GMT709	GMT710	GMT711	GMT712	GMT713	GMT714	GMT715	GMT716	GMT717	GMT718	GMT719	GMT720	GMT721	GMT722	GMT723	GMT724	GMT725	GMT726	GMT727	GMT728	GMT729	GMT730	GMT731	GMT732	GMT733	GMT734	GMT735	GMT736	GMT737	GMT738	GMT739	GMT740	GMT741	GMT742	GMT743	GMT744	GMT745	GMT746	GMT747	GMT748	GMT749	GMT750	GMT751	GMT752	GMT753	GMT754	GMT755	GMT756	GMT757	GMT758	GMT759	GMT760	GMT761	GMT762	GMT763	GMT764	GMT765	GMT766	GMT767	GMT768	GMT769	GMT770	GMT771	GMT772	GMT773	GMT774	GMT775	GMT776	GMT777	GMT778	GMT779	GMT780	GMT781	GMT782	GMT783	GMT784	GMT785	GMT786	GMT787	GMT788	GMT789	GMT790	GMT791	GMT792	GMT793	GMT794	GMT795	GMT796	GMT797	GMT798	GMT799	GMT800	GMT801	GMT802	GMT803	GMT804	GMT805	GMT806	GMT807	GMT808	GMT809	GMT810	GMT811	GMT812	GMT813	GMT814	GMT815	GMT816	GMT817	GMT818	GMT819	GMT820	GMT821	GMT822	GMT823	GMT824	GMT825	GMT826	GMT827	GMT828	GMT829	GMT830	GMT831	GMT832	GMT833	GMT834	GMT835	GMT836	GMT837	GMT838	GMT839	GMT840	GMT841	GMT842	GMT843	GMT844	GMT845	GMT846	GMT847	GMT848	GMT849	GMT850	GMT851	GMT852	GMT853	GMT854	GMT855	GMT856	GMT857	GMT858	GMT859	GMT860	GMT861	GMT862	GMT863	GMT864	GMT865	GMT866	GMT867	GMT868	GMT869	GMT870	GMT871	GMT872	GMT873	GMT874	GMT875	GMT876	GMT877	GMT878	GMT879	GMT880	GMT881	GMT882	GMT883	GMT884	GMT885	GMT886	GMT887	GMT888	GMT88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Exhibit B



US005788270A

United States Patent [19]
HÅland et al.

[11] **Patent Number:** **5,788,270**
[45] **Date of Patent:** **Aug. 4, 1998**

[54] **SIDE IMPACT AND ROLL OVER
INFLATABLE HEAD PROTECTOR**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** ⁶ **B60R 21/22**; B60R 21/24;
B60R 21/08

[52] **U.S. Cl.** **280/729**; 280/730.2; 280/749

[58] **Field of Search** 280/730.2, 730.1,
280/729, 743.1, 743.2, 728.1, 753, 749

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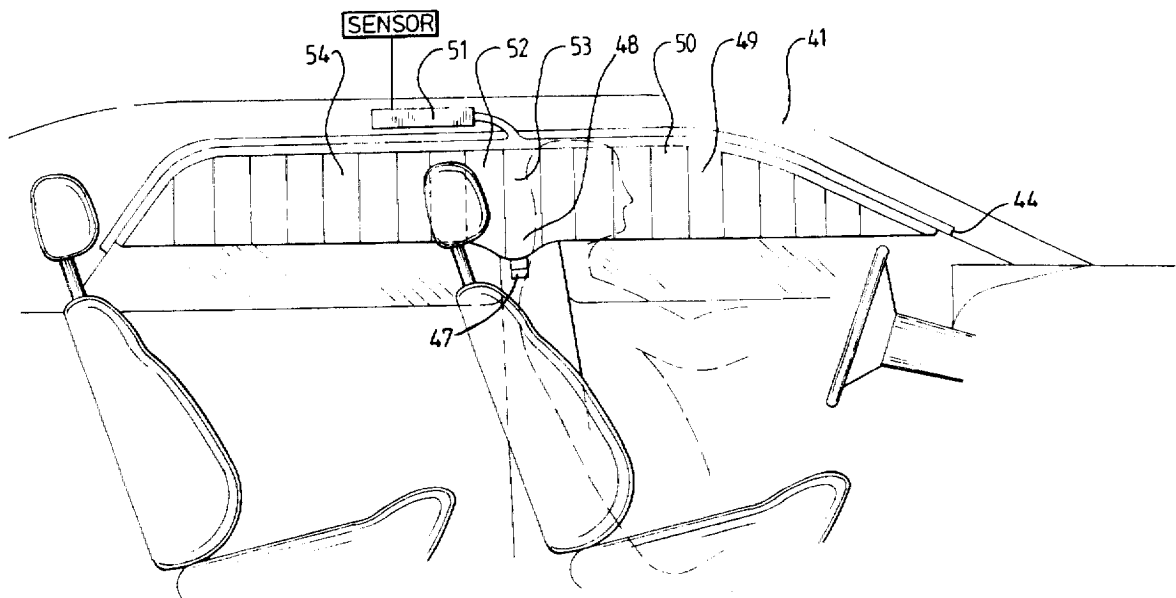
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Primary Examiner—Peter C. English
Attorney, Agent, or Firm—Spencer & Frank

[57] **ABSTRACT**

A safety device for a motor vehicle which has a door frame and a door contained within the door frame. The safety device includes: a gas generator; a sensor for sensing at least one of a side impact and a roll-over for activating the gas generator; and an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator. The inflatable element can thus assume a non-inflated mode and an inflated mode and can further be positioned adjacent the door in an inflated-mode thereof. The inflatable element is further made of fabric and includes: a first fabric layer defining a front part thereof; a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together. The inflatable element thus incorporates a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned. The inflatable element further includes an upper edge portion which is configured to be secured to the door frame all along a non-linear part of the door frame.

14 Claims, 5 Drawing Sheets

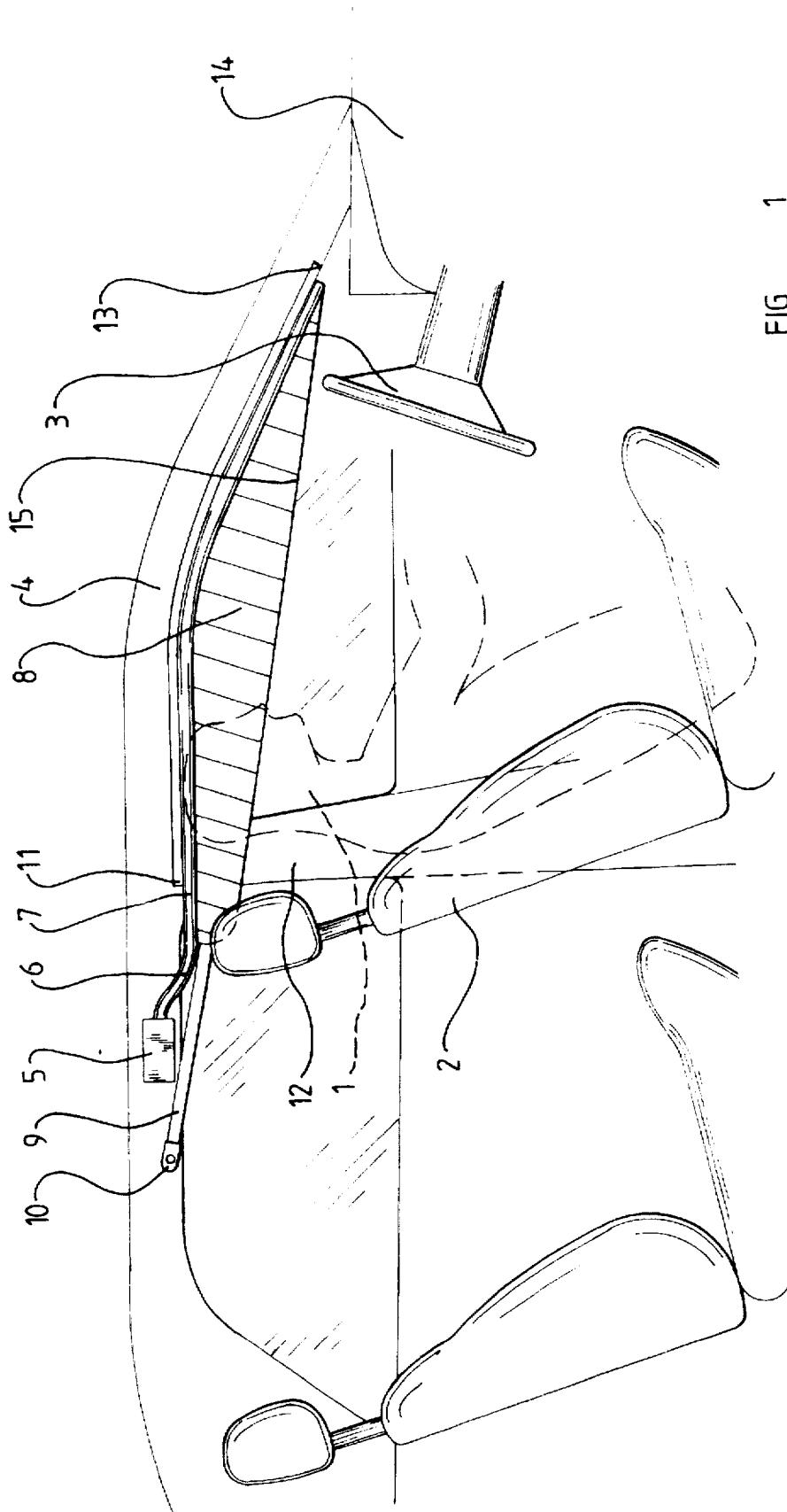


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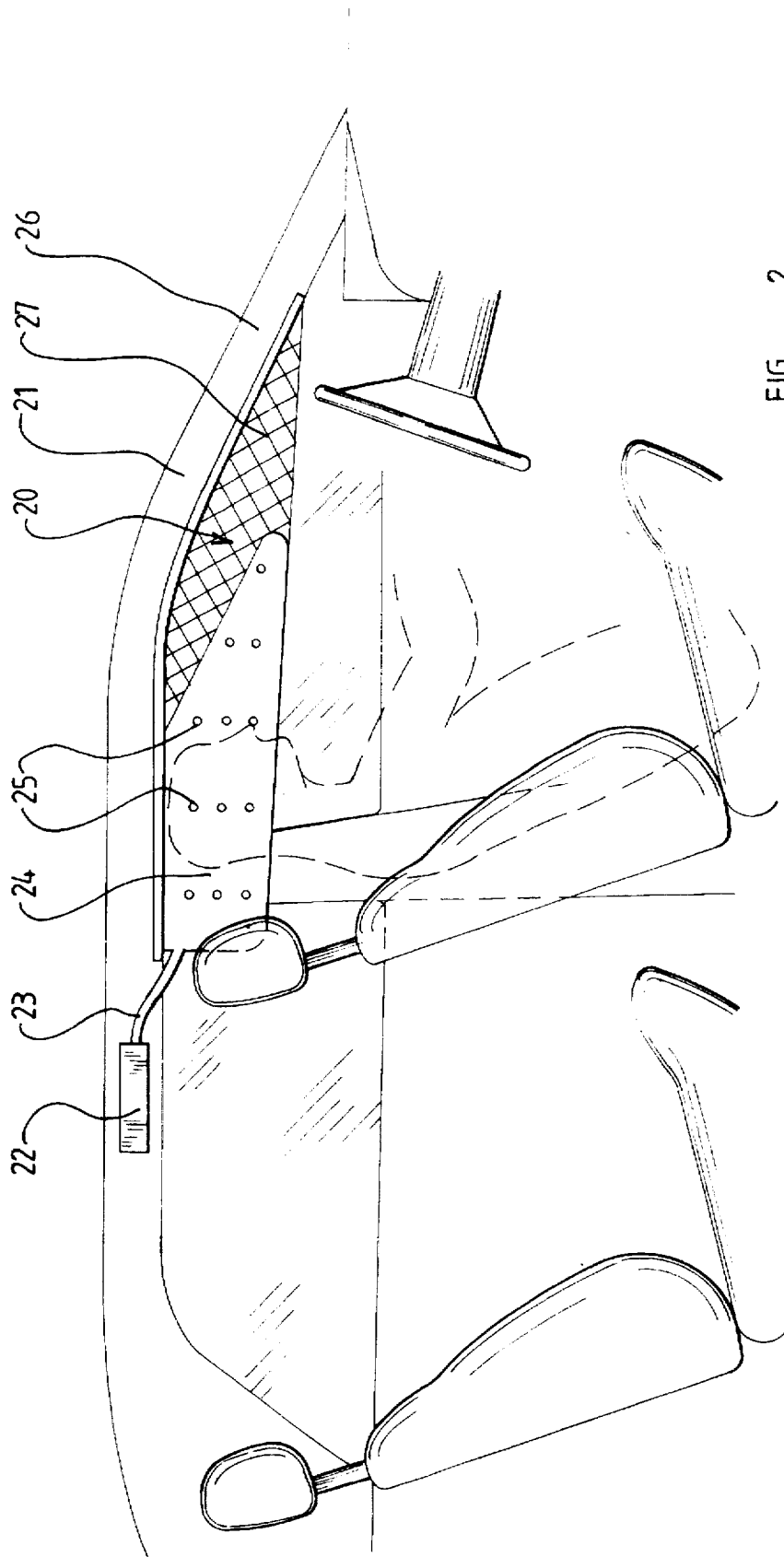


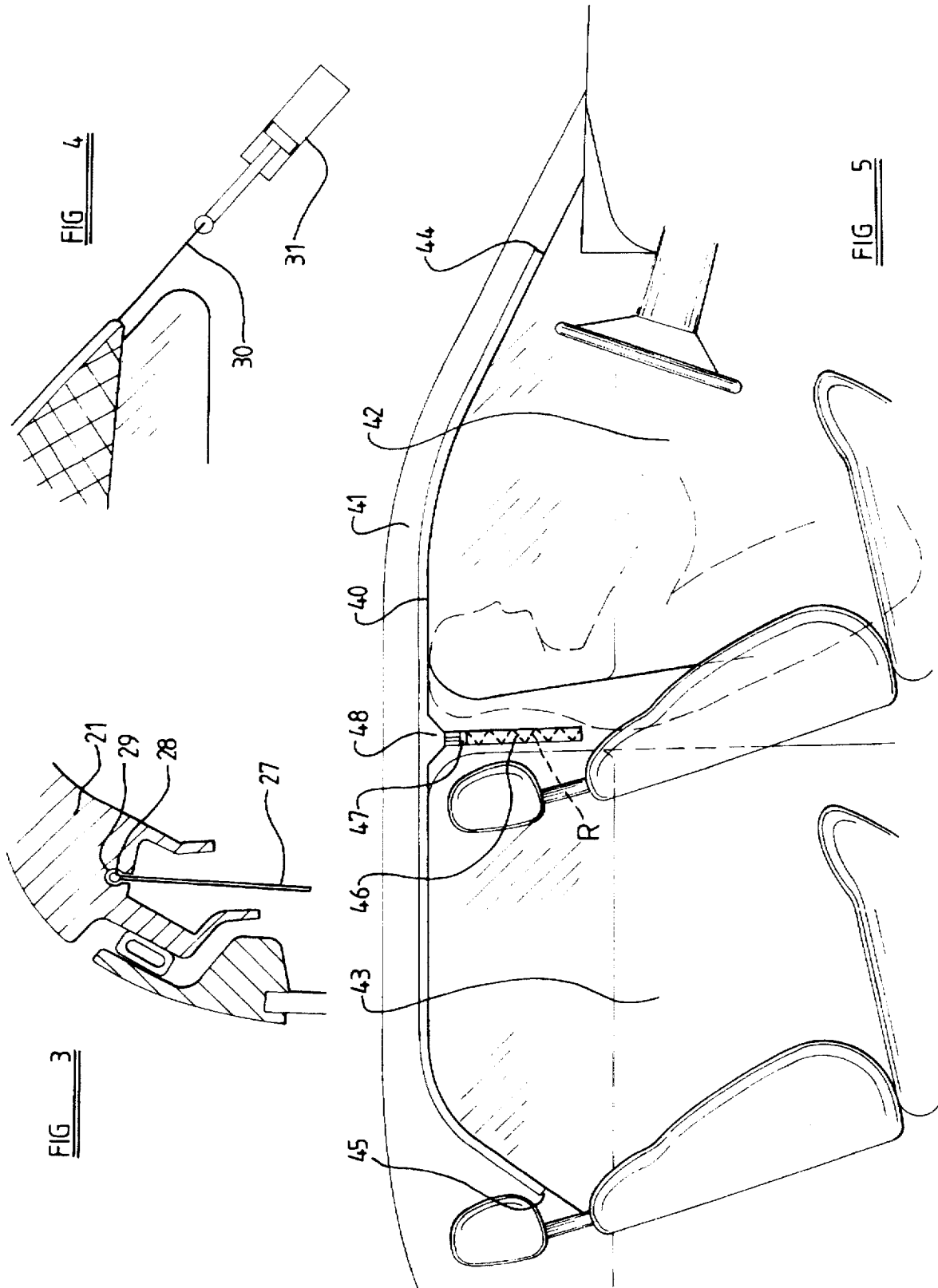
FIG. 2

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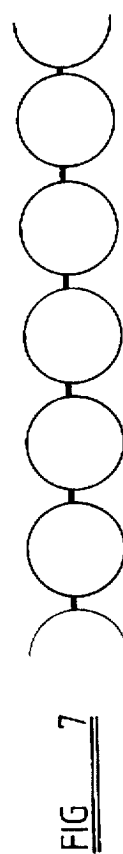
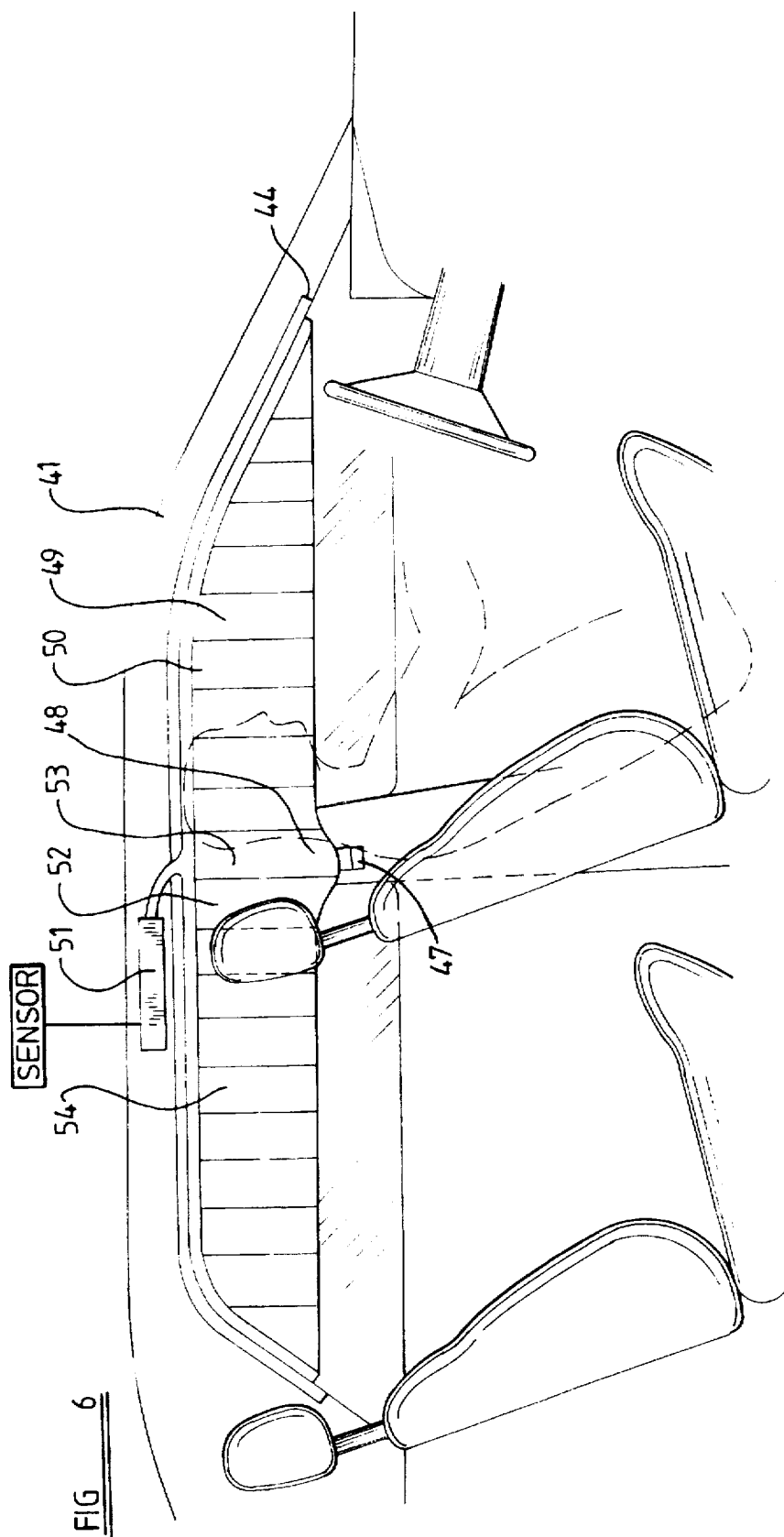


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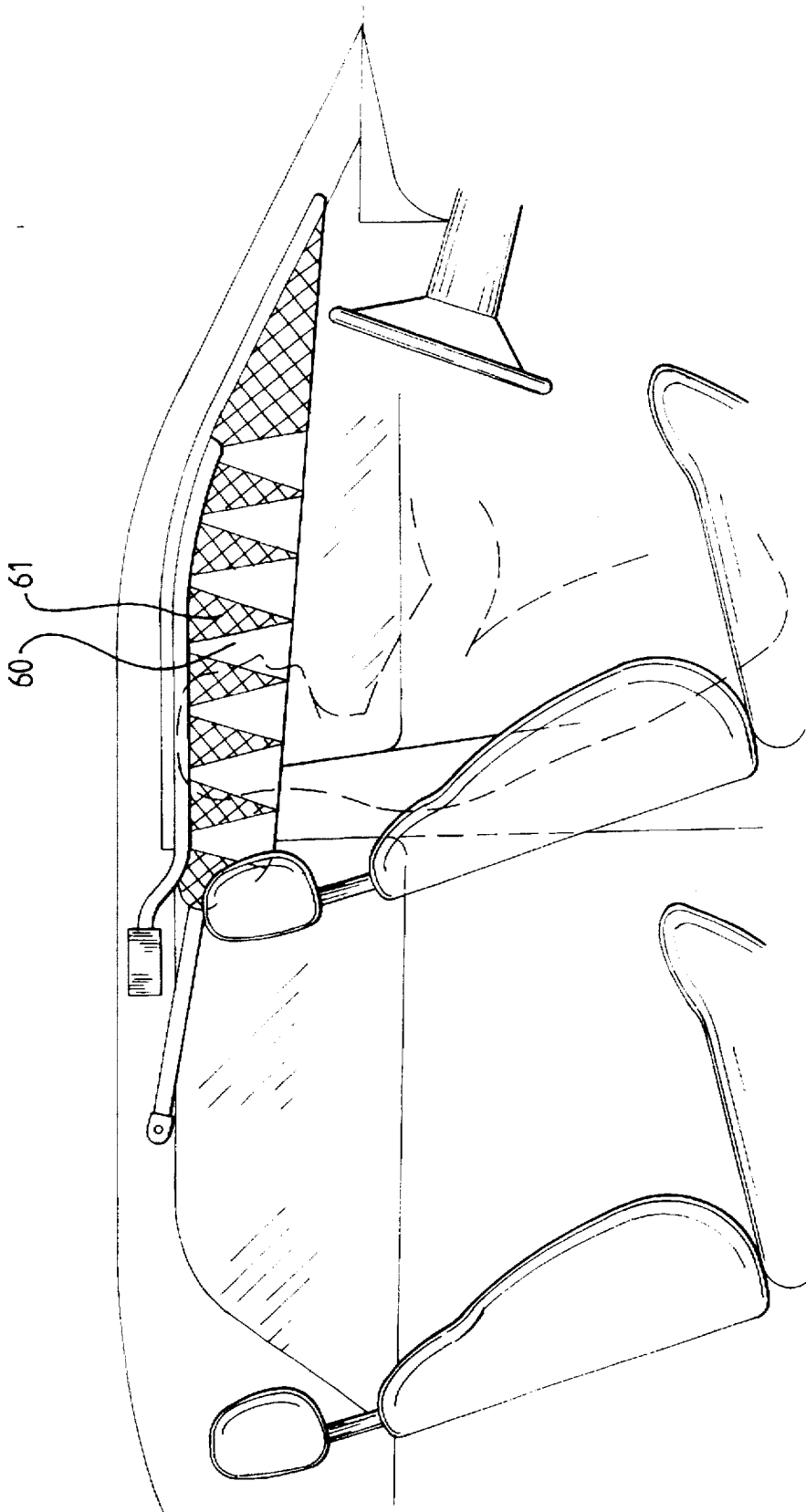


FIG. 9

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SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR

FIELD OF THE INVENTION

THIS INVENTION relates to a safety device, and more particularly relates to a safety device in a motor vehicle such as a motor car.

BACKGROUND OF THE INVENTION

When a motor vehicle is involved in an accident there is a risk that the driver and passengers within the vehicle will be injured. It has been proposed to provide vehicles with safety devices to reduce the risk of such injury.

Certain safety devices are intended to provide protection in the case of a side impact. U.S. Pat. No. 5,322,322 discloses such a device. An inflatable tube is initially stored in a recess in the door frame above the door of the vehicle, and the ends of the tube are pivotally anchored to fixed points on the door frame. A sensor is provided to sense when an accident occurs, and to initiate inflation of the tube. As the tube inflates its length decreases, and it then extends linearly between the two fixed points on the door frame. The inflated tube provides some protection for the head of a person sitting in the vehicle. However, the tube is inflated to a substantial pressure, and thus the head of a person in the vehicle may tend to bounce off the tube. The tube may not cover the whole of the area of the window, and may not even cover the whole of the upper part of the window. There is thus a risk that the head of the person in the vehicle may move past the tube and pass through the window opening. If a car is rolling over this is very undesirable.

SUMMARY OF THE INVENTION

This invention seeks to provide an improved safety device.

According to this invention there is provided a safety device in a motor vehicle, the device comprising a gas generator, incorporating or associated with a sensor adapted to sense a side impact or a roll-over and to activate the gas generator, and an inflatable element connected to the gas generator to be inflated by gas from the gas generator, the inflatable element being made of fabric comprising a first layer to define the front part of the inflatable element, and a second layer to define the back part of the inflatable element, selected parts of the first layer and the second layer being inter-connected to define points or lines where the front part and back part of the inflatable element are secured together, the inflatable element incorporating a plurality of substantially parallel elongate cells, the inflatable element having an edge portion secured to part of the door frame of the vehicle which is non-linear, the inflatable element, when inflated, being positioned adjacent the door contained within the door frame.

The inflatable element, when inflated, is thus located between the head of a person sitting in the vehicle and an adjacent door. Usually such a door is provided with a window and so the inflated element provides protection from breaking glass from the window, and also prevents the head of the person in the vehicle from striking the window, or from being thrown out through the window, as can happen, particularly with roll-over accidents.

Preferably the safety device is usually initially stored in a recess provided in the doorframe.

Preferably the inflatable element is made of interwoven fabric layers, the selected parts of the first layer and the

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second layer being inter-woven. Preferably there is internal venting between the cells as this may reduce undesirable bounce that might occur if the cells were discrete and not vented to each other.

The cells may be immediately adjacent each other or may be spaced apart. At least some of the cells may be of conical form when inflated.

The inflatable element may be formed of a fabric with parts of the fabric being interwoven to form the cell or cells. The fabric may have a single layer weight of less than 300 g/sq m, such as a weight of 175 g/sq m.

Preferably when the inflatable element is inflated the pressure of gas is approximately 3 bar. Preferably the inflatable element, when inflated, extends past the B-post of the vehicle, to provide protection for the head of the driver. If the head of the driver should impact with the B-post in an accident the consequences could be fatal.

In one embodiment the inflatable element incorporates a strap to connect part of the inflatable element to the door-frame. The strap is tight, that is, tensioned to a significant extent, when the inflatable element is inflated.

Separate means may be provided to apply tension to part of the inflatable element then it is inflated, such as a piston and cylinder, adapted to be moved by gas from a gas generator when the inflatable element is inflated, to apply tension to one edge of the inflatable element, to hold the inflated element in a desired position.

In one embodiment the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain the means in the further position. Thus a slider may be provided adapted to slide along a ratchet, and to be retained by the ratchet when it has moved to a further position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which

FIG. 1 is a side view of the interior of a motor vehicle illustrating a safety device in accordance with the invention in an operative state,

FIG. 2 is a side view of part of the interior of a motor vehicle illustrating another safety device in accordance with the invention in the operative state,

FIG. 3 is a sectional view of part of the embodiment of FIG. 2 in a plane perpendicular to a longitudinal axis of the vehicle,

FIG. 4 is a view of part of FIG. 2 showing an additional component of the safety device,

FIG. 5 is a side view of the interior of a motor vehicle provided with another form of safety device in accordance with the invention, before the safety device moves to the operative state,

FIG. 6 illustrates the vehicle of FIG. 5 when the safety device is in the operative state,

FIG. 7 is a sectional view of one form of safety device as shown in FIG. 1 or in FIGS. 5 and 6 in a plane perpendicular to a longitudinal axis of the vehicle,

FIG. 8 is a sectional view of another form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, and

FIG. 9 is a view of part of an alternative inflatable element for use in the embodiments of FIGS. 1, 5 and 6.

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DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 1 a safety device is illustrated which is intended to provide protection for a person 1 sitting in a seat 2 in the vehicle. In any accident in which the vehicle is decelerated the person will tend to move forwardly towards the steering wheel 3, but will be restrained by a conventional seat belt or air-bag. In the case of a side impact or roll-over, there is a risk that the head of the person 1 will strike the window in the door beside the person, or strike the B-post. There is also a risk that if, as most commonly happens, the glass in the window should break, the head of the person 1 may be thrown out of the window, especially in the case of roll-over.

The safety device shown in the operative state in FIG. 1 is initially retained in a recess provided in the door frame 4 located above the door of the vehicle. The recess extends over more than simply a linear portion of the door frame so that the two ends of the recess are not in alignment with the main part of the recess.

The safety device comprises a gas generator 5, which is adapted to generate gas, such as cold gas. The gas generator incorporates, or is associated with, a sensor which senses a side impact and/or a roll-over situation to activate the gas generator at an appropriate instant. The gas generator is connected by a hose 6 to a duct 7. The duct 7 forms part of an inflatable element. The inflatable element incorporates a plurality of parallel substantially vertical, substantially cylindrical cells 8. The inflatable element may be made of interwoven fabric. Such a fabric comprises a first layer that defines the front of the inflatable element—that is to say the part that is visible in FIG. 1—and a second layer that defines the back part—that is to say the part that is adjacent the window in FIG. 1—selected parts of the first region and the second region being interwoven to define links in the form of points or lines where the front part and the back part of the inflatable element are secured together. A technique for making an inflatable element of inter-woven fabric is described in more detail in International Patent Publication W090/09295.

A webbing strap 9 that forms part of the inflatable element extends from the end of the inflatable element near the duct 7 which is connected to the hose 6 to an anchoring point 10 on the door frame 4. The edge of the duct 7 between the points 11, adjacent the top of the B-post 12, and 13, at the lower part of the A-post, in the region of the dashboard 14, is fixed securely to the door frame 4, consequently, it is to be understood that the upper edge of the inflatable element has a non-linear configuration which conforms with the non-linear configuration of the upper part of the door frame 4 by virtue of the inflatable element being secured, at an upper edge portion thereof, to the door frame all along a non-linear part of the door frame as shown in the figures. A substantial part, in fact virtually all, of the upper edge of the inflatable element is secured to the upper part of the door frame.

When an accident such as side impact occurs the gas generator generates cold gas which passes through the hose 6 to the duct 7, and then inflates the cells 8. The inflatable element thus moves from its initial stored position within the recess in the door frame to the operative position shown in FIG. 1. The inflatable element then extends downwardly from the top of the door frame to form a flat structure located between the head of the person 1 and the adjacent window. As the cylindrical cells inflate the length of the lower edge 15 of the inflatable element is reduced, and thus the lower

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edge, together with the webbing strap 9 extend substantially tightly from the point 10 to the point 13. It is to be noted that the part of the doorframe 4 between the points 10 and 13 is not linear, and defines, with the linear lower edge of the inflated element, a triangular area which is covered by the inflated element.

The lower edge of the inflated element decreases by about 10% between the uninflated state and the inflated state. The inflated element is fully inflated within about 15 ms. The total thickness of the inflated element, when inflated is approximately 30–40 mm. The seams of interweaving of the front part and the back part of the inflated element are approximately 30–40 mm apart, so that the resultant cells are cylindrical when inflated. The total volume of gas within the inflated element may be between 7 and 9 litres, and the gas may be at a pressure of about 3 bar. While the inflated element is not provided with a vent to vent gas from within the element to the atmosphere, so that the inflated element, when inflated, remains inflated for a long period of time—to provide protection in the case of a protracted roll-over—there is venting between at least selected adjacent cells 8, to avoid any severe rebound. Thus if the head of the person in the vehicle impacts with the inflated element the pressure of gas within the whole element, or at least a substantial part of the element will rise, thus giving a “soft” impact. If each cell were sealed with no venting of this type, there would be a risk of severe rebound.

The weight of the fabric should be kept to be as low as possible, so that if the inflatable element should impact with the head of the person in the vehicle as the inflatable element is inflated no harm will be done. It is thought that a material having a weight of less than 300 g/sq m, such as 175 g/sq m may be used.

It is to be noted that part of the inflated element extends rearwardly beyond the point 11, and is thus located between the head of the person 1 and the top of the B-post. Thus the risk of the head of the person impacting with the B-post is minimised. Since the upper edge of the inflatable element is secured to the upper part of the door frame along substantially the whole of its length, there is virtually no risk that the head of the occupant will pass between the upper edge of the inflatable element and the upper part of the door frame, with the head of the occupant of the vehicle thus inadvertently emerging from the body shell of the vehicle.

FIGS. 2 to 4 illustrate a second embodiment of the invention. In this embodiment an inflatable element 20 is provided which is initially stored in a recess provided in the door frame 21 of a motor vehicle. A gas generator 22 is provided, which again incorporates or is associated with a sensor or detector which activates the gas generator at an appropriate time. The gas generator is connected by a duct 23 to an inflatable part 24 of the inflatable element 20. The gas generator 22 is located in the door frame 21 of the vehicle, but alternatively could be positioned in the B-post.

The inflatable part 24 of the inflatable element 20 is formed from two layers of fabric, as in the embodiment of FIG. 1, with the front layer and the back layer of the fabric being woven together at selected points 25. The selected points 25 are arranged in vertically extending columns and serve to divide the inflatable part 24 into a plurality of vertical parallel chambers. The spaces between the selected points 25 permit internal venting between adjacent chambers.

The inflatable part 24 of the inflatable element 20 is adapted to be located adjacent the head of an occupant of the motor vehicle, and, towards the rear of the inflatable

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element, when in the position illustrated in FIG. 2, the inflatable part of the inflatable element extends from the top to the bottom of the inflatable element in a rear region and subsequently, the upper edge of the inflatable part extends downwardly towards the lower edge of the inflatable element, in a sense directed towards the A-Post 26. The remaining part of the inflatable element comprises a web or sheet 27 which extends from the inflatable part 24 to the part of the door frame 21 above the door and to the A-post. The web or sheet 27 is thus secured to parts of the doorframe that are non-linear. It is to be appreciated, therefore, that in this embodiment of the invention the upper edge of the inflatable element is of non-linear form and is of the same configuration as the non-linear part of the door frame which extends forwardly from the B-post and which incorporates the A-post. The upper edge of the inflatable element, or at least a substantial part of that upper edge, is securely fixed to the upper part of the door frame, thus again minimizing any risk of the head of the occupant emerging from the body shell between the upper edge of the inflatable element and the upper part of the door frame.

Referring to FIG. 3 the edge of the sheet 27 that is secured to the door frame 21 may terminate with a bead 28 that is received within a slot 29 formed in the door frame, the mouth of the slot being narrower than the base so that the bead 28 can slide axially within the slot, but cannot escape from the slot. A cable 30 is connected to the end of the bead, as can be seen in FIG. 4, the cable being connected to a tensioning device 31. The tensioning device may comprise a piston in a cylinder associated with a gas generator to generate gas which moves the piston within the cylinder to apply tension to the cable 30 and thus to the bead 28. A ratchet or the like may hold the piston in place when it has been moved by the gas. The gas generator that supplies gas to the piston may be the gas generator 22 or may be a separate gas generator that is triggered simultaneously with the main gas generator.

When an accident occurs the inflatable element 20 moves from its stored position to the operative position shown in FIG. 2, and tension is applied to the inflatable element 20 by the distension of the inflatable part 24, and by the tension applied to the bead 28. The inflated element 20 is thus held firmly in position to provide protection for the head of the person sitting in the motor vehicle. The thickness of the element 20 and the weight of the material used should be as described with reference to the embodiment of FIG. 1.

FIGS. 5 and 6 illustrate another embodiment of the invention intended to provide protection not only for a person in the front seat of a motor vehicle such as a motor car, but also for a person in the rear seat of the vehicle.

Referring to FIG. 5, a recess 40 is provided in the doorframe 41 of a motor vehicle, the recess extending over both the front door 42 and the rear door 43. The recess extends from a point 44 located near the lower end of the A-post to a point 45 located near the lower end of the C-post.

A channel 46 is provided on the B-post, extending vertically. In the channel 46 is a ratchet R, and received within the upper end of the channel 46 is a ratchet engaging slide member 47. The slide member 47 is connected to a tab 48 which forms part of an inflatable element 49, which is initially stored within the recess 40.

The inflatable element 49 (see FIG. 6) is shown in the inflated state in FIG. 6. The inflatable element has its top edge 50 secured to the part of the door frame 41 that extends above the doors 42, 43 of the motor vehicle. The top edge of the inflatable element is of non-linear configuration, and

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has a configuration which corresponds with the nonlinear configuration of the upper part of the door frame. The design of the inflatable element is similar to that shown in FIG. 1, with the inflatable element presenting a plurality of parallel cells, which when inflated are substantially cylindrical. The structure of the inflatable element 49 may be the same as that described with reference to FIG. 1.

A gas generator 51 is provided which is connected to the inflatable element in such a way that when the gas generator is activated by a sensor that is formed integrally with the gas generator, or which is associated with the gas generator, and which responds to a side impact or to a roll-over situation to activate the gas generator, gas is initially supplied to the cells 52, 53, which are aligned with the tab 48. Thus initially, as the inflatable element 49 inflates, the cells 52 and 53 inflate and move the ratchet engaging slide member 47 downwardly. The ratchet engaging slide member thus moves down the slot 46 to the position shown in FIG. 6. The ratchet engaging slide member 47 engages the ratchet, and thus holds the tab 48 in its lower position.

The rest of the cells 54 of the inflatable element are then inflated, and the inflatable element then extends fully across the upper parts of the windows in the doors 42, 43 of the motor vehicle. It can be seen that the lower edge of the inflated element 49 extends between the points 44 and 45 at the ends of the recess 40. As the inflatable element 49 inflates, so the length of the lower edge thereof decreases as a consequence of the inflation of the cells of the inflatable element. This reduction in the length of the lower edge, together with the action of the ratchet engaging slide member 47 ensures that the inflated element is retained in position as illustrated after it has been inflated.

FIG. 7 is a cross section showing the nature of the cells of the inflated element of FIG. 1 and of FIGS. 5 and 6. It can be seen that the cells are immediately adjacent to each other and are only separated by narrow regions where the fabric forming the front part of the inflated element has been woven with the fabric forming the back part of the inflated element. However, FIG. 8 illustrates an alternative possibility, in which the regions of fabric between the cells that are woven together are relatively wide, the cells thus being separated by webs of fabric. The advantage of this latter possibility is that a smaller volume of gas may be required to fully inflate the inflatable element, meaning that the inflatable element may be inflated more rapidly.

FIG. 9 illustrates an alternative form of inflatable element comprising a plurality of cells 60. The upper edge of the inflatable element is of non-linear form and is connected to the non-linear portion of the door frame above the door. The configuration of the upper edge of the inflatable element and the configuration of the door frame correspond. It can be seen that each cell 60 is of substantially conical form, the cells being arranged adjacent each other and being parallel with each other. Between the cells are inverted triangular portions 61 where the fabric forming the cells is interwoven.

When cells of this type are inflated, the length of the lower edge of the arrangement contracts, whereas the length of the upper edge of the arrangement remains constant.

An arrangement of this type can be used, therefore, to ensure that the lower edge of the element, when inflated, is under some tension.

Whilst in the arrangement illustrated in FIG. 9, the cells are immediately adjacent each other, it is to be appreciated that a similar effect may be achieved if the cells are spaced apart. It is possible to replace at least part of the inverted triangular region 61 with further conical cells of an inverted orientation.

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Whilst in the described embodiments of the invention, the inflatable element has been described as being made utilising a technique in which two layers of fabric are inter-woven to define points or lines where the front layer and the rear layer are inter-woven, it would be possible to form embodiments of the invention utilising two discrete layers of fabric which are inter-connected by stitching.

We claim:

1. A safety device for a motor vehicle having a door frame, a door contained within the door frame, and a B-post, the safety device comprising:

a gas generator;

a sensor operatively connected to the gas generator for sensing at least one of a side impact and a roll-over for activating the gas generator; and

an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator, the inflatable element thereby being adapted to be in a non-inflated mode and in an inflated mode and further being adapted to be positioned adjacent the door in the inflated mode thereof, the inflatable element further being made of fabric and comprising:

a first fabric layer defining a front part thereof;

a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together, the inflatable element thereby incorporating a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned; and

an upper edge portion adapted to be secured to the door frame all along a non-linear part of the door frame, the cells being configured to extend substantially from the upper edge portion of the inflatable element to the lower edge portion of the inflatable element.

2. The safety device according to claim 1, wherein the inflatable element, in its non-inflated mode, is adapted to be stored in a recess of the door frame.

3. The safety device according to claim 1, wherein the first fabric layer and the second fabric layer are interconnected at the selected parts thereof by being interwoven with one another at the respective links.

4. The safety device according to claim 1, wherein the cells are configured to be in gas flow communication with one another.

5. The safety device according to claim 1, wherein the cells are immediately adjacent each other.

6. The safety device according to claim 1, wherein the cells are spaced apart with respect to one another.

7. The safety device according to claim 1, wherein at least some of the cells have a conical shape in the inflated mode of the inflatable element.

8. The safety device according to claim 1, wherein the inflatable element is made of a fabric having a single layer weight of less than 300 g/sq m.

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9. The safety device according to claim 1, wherein a pressure in the inflatable element is approximately 3 bar when the inflatable element is in its inflated mode.

10. The safety device according to claim 1, wherein the inflatable element, in its inflated mode, is adapted to extend past the B-post of the vehicle.

11. The safety device according to claim 1, further comprising a strap connected to a part of the inflatable element and further adapted to connect the part of the inflatable element to the door frame.

12. The safety device according to claim 1, further comprising a tensioning device for applying tension to the inflatable element when the inflatable element is in its inflated mode.

13. The safety device according to claim 1, further comprising position retaining means connected to a part of the inflatable element for retaining a position of the part of the inflatable element on the door frame when the inflatable element is in its inflated mode, the position retaining means comprising:

a component adapted to move from an initial position to a further position upon inflation of the inflatable element; and

means operatively connected to the component for retaining the component in the further position.

14. A safety device for a motor vehicle having a door frame and both a front door and a rear door contained within the door frame, the safety device comprising:

a gas generator;

a sensor operatively connected to the gas generator for sensing at least one of a side impact and a roll-over for activating the gas generator; and

an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator, the inflatable element thereby being adapted to be in a non-inflated mode and in an inflated mode and further being adapted to be positioned adjacent both the front door and the rear door in the inflated mode thereof, the inflatable element further being made of fabric and comprising:

a first fabric layer defining a front part thereof;

a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together, the inflatable element thereby incorporating a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned; and

an upper edge portion adapted to be secured to the door frame all along a non-linear part of the door frame which extends over both the front door and the rear door, the cells being configured to extend substantially from the upper edge portion of the inflatable element to the lower edge portion of the inflatable element.

* * * * *

Exhibit C

(12) **United States Patent**
Haland et al.

(10) **Patent No.:** **US 6,623,031 B2**
(45) **Date of Patent:** ***Sep. 23, 2003**

(54) **SIDE IMPACT AND ROLL OVER
INFLATABLE HEAD PROTECTOR**

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claimer.

(21) Appl. No.: **10/284,155**

(22) Filed: **Oct. 31, 2002**

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Related U.S. Application Data

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28, 2001, now Pat. No. 6,494,480, which is a continuation
of application No. 09/589,402, filed on Jun. 8, 2000, now
Pat. No. 6,312,009, which is a continuation of application
No. 09/127,918, filed on Aug. 3, 1998, now Pat. No.
6,099,029, which is a continuation of application No.
08/604,052, filed on Feb. 20, 1996, now Pat. No. 5,788,270.

(30) **Foreign Application Priority Data**

Feb. 20, 1995 (GB) 9503267

(51) **Int. Cl.**⁷ **B60R 21/22; B60R 21/24**

(52) **U.S. Cl.** **280/729; 280/730.2**

(58) **Field of Search** 280/730.2, 730.1,
280/729, 743.1, 743.2, 728.1, 753, 749

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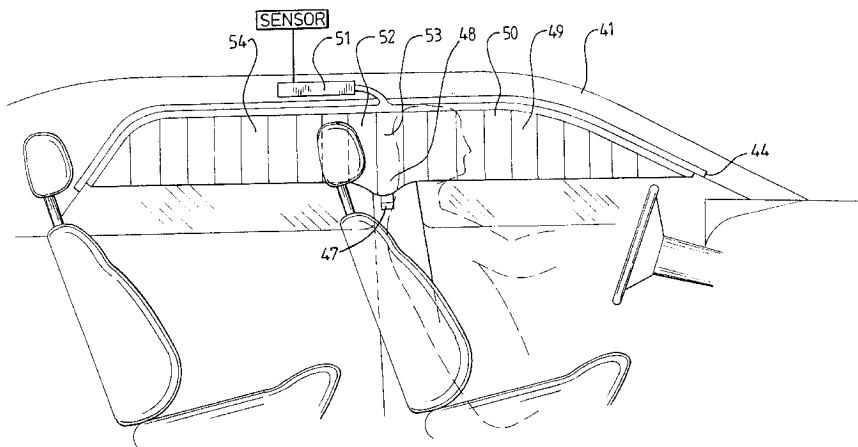
Primary Examiner—Peter C. English

(74) *Attorney, Agent, or Firm*—Venable LLP; Robert
Kinberg; Catherine M. Voorhees

(57) **ABSTRACT**

A safety device for a motor vehicle which has a door frame and a door contained within the door frame. The safety device includes: a gas generator; a sensor for sensing at least one of a side impact and a roll-over for activating the gas generator; and an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator. The inflatable element can thus assume a non-inflated mode and an inflated mode and can further be positioned adjacent the door in an inflated-mode thereof. The inflatable element is further made of fabric and includes: a first fabric layer defining a front part thereof; a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together. The inflatable element thus incorporates a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned. The inflatable element further includes an upper edge portion which is configured to be secured to the door frame all along a non-linear part of the door frame.

6 Claims, 5 Drawing Sheets



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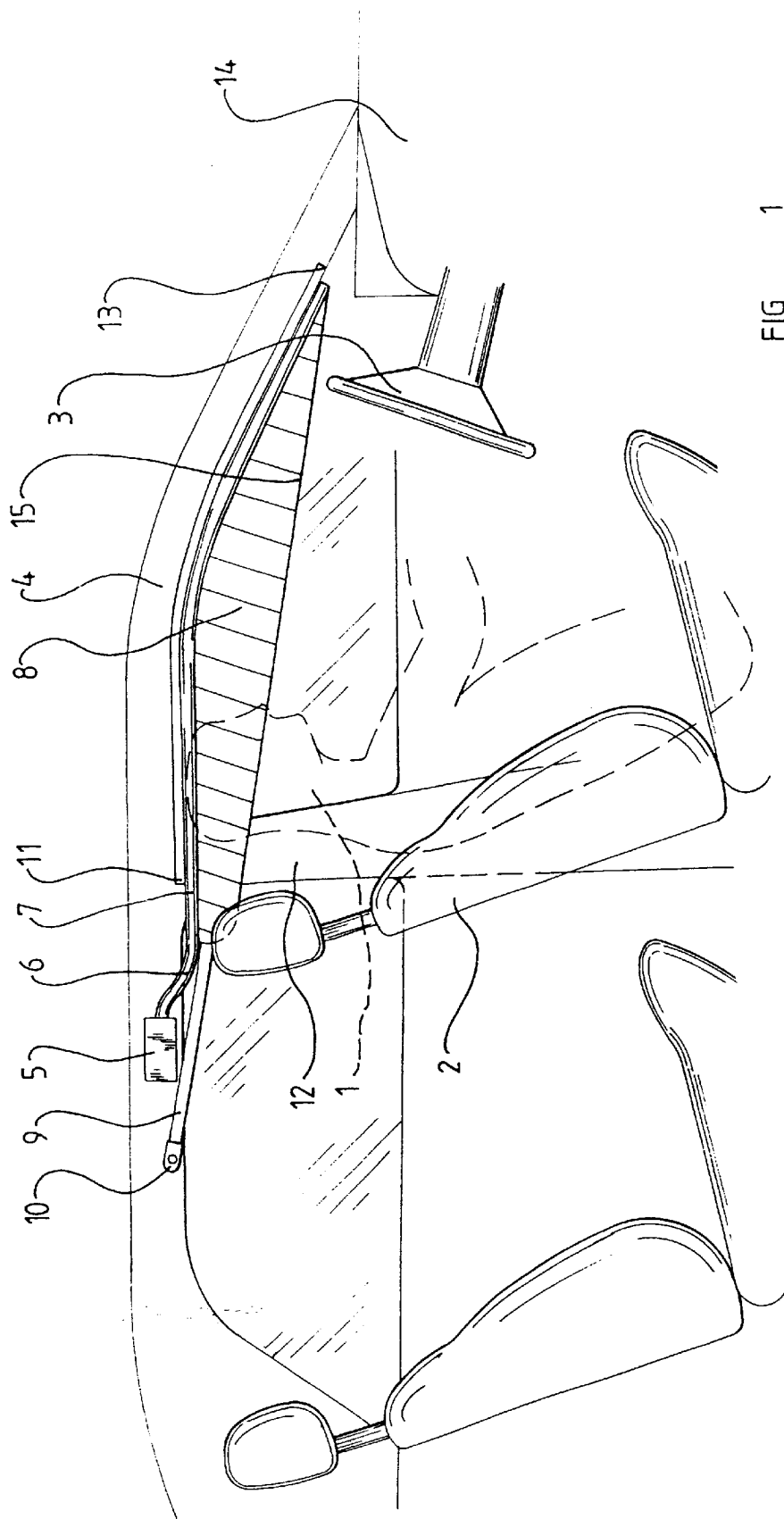
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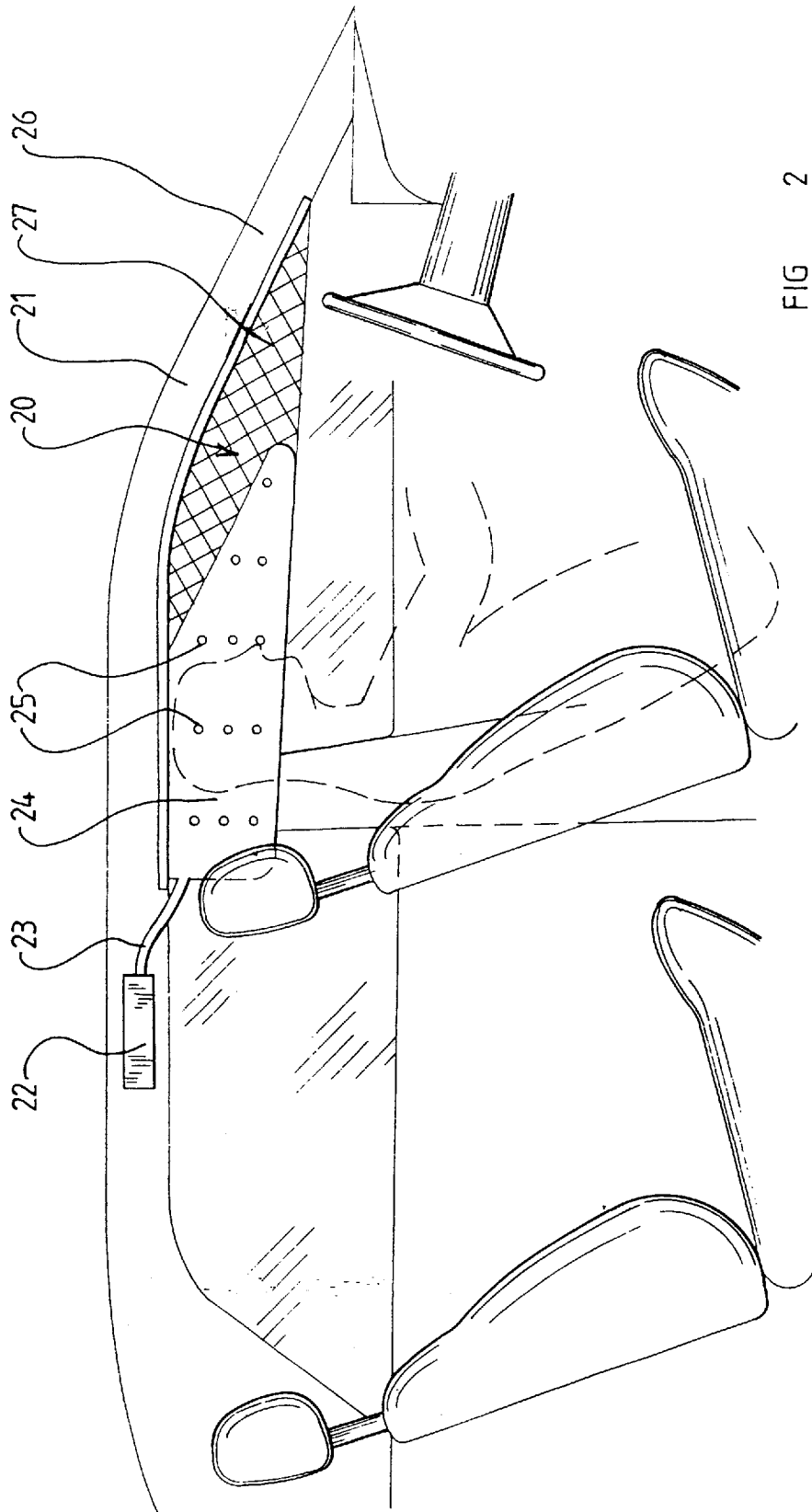


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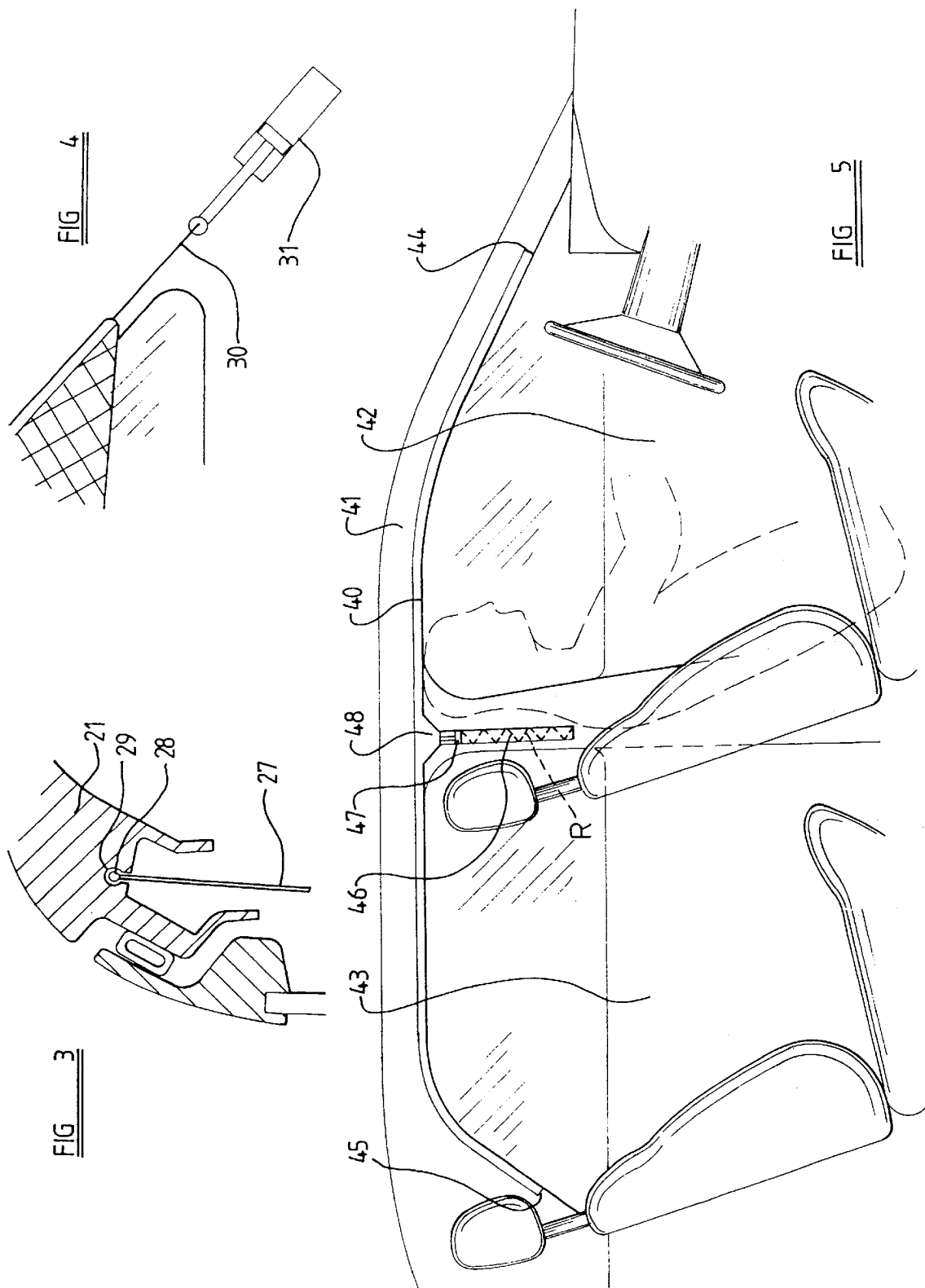


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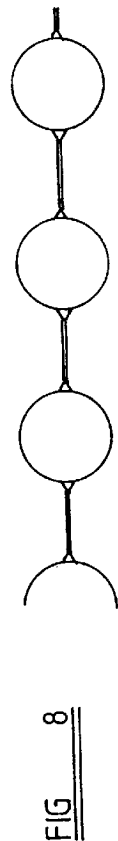
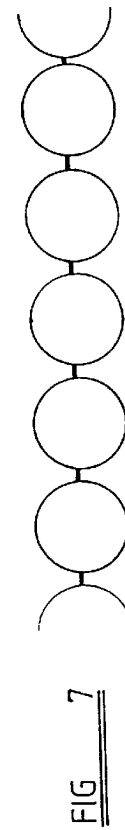
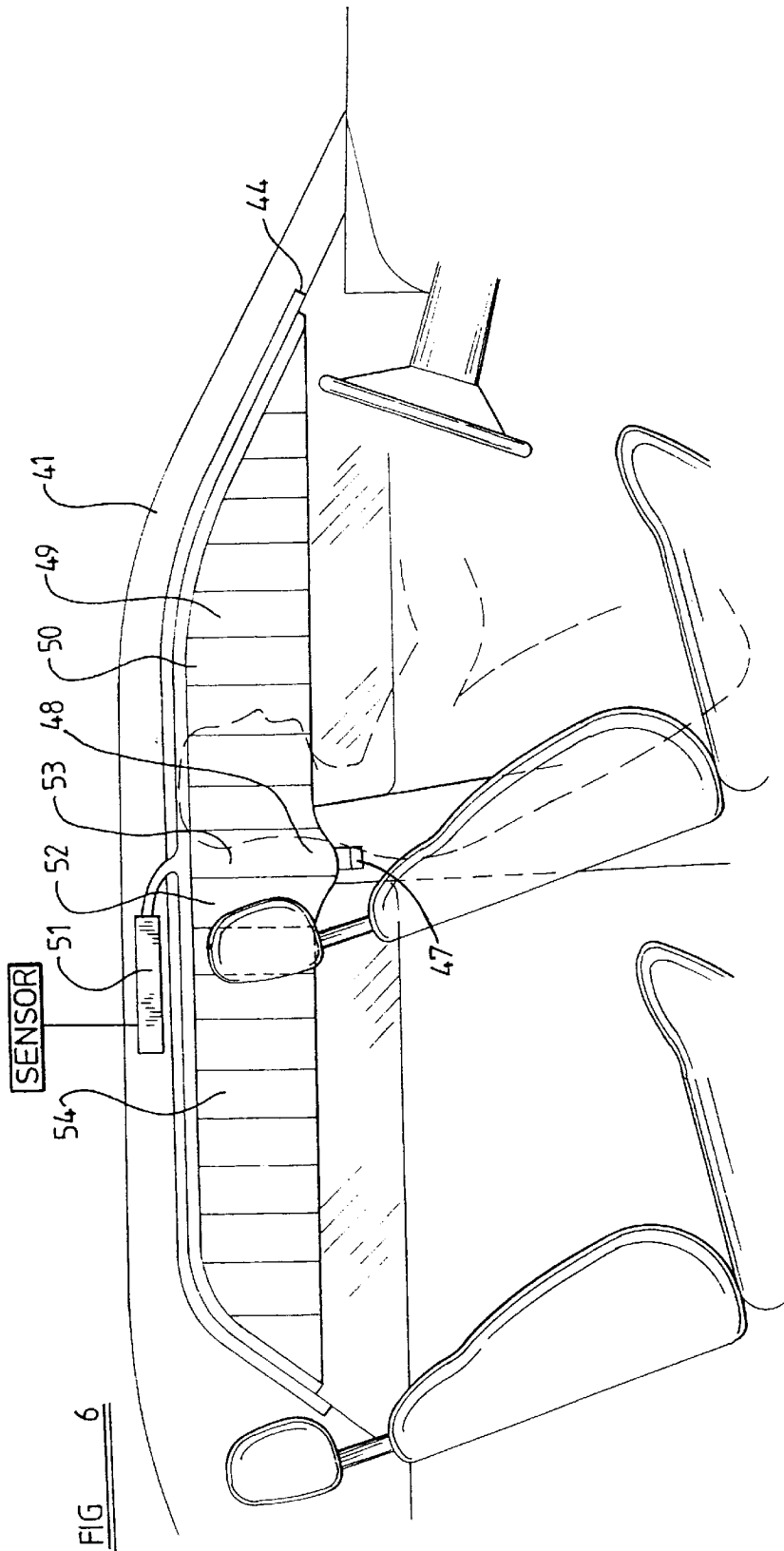


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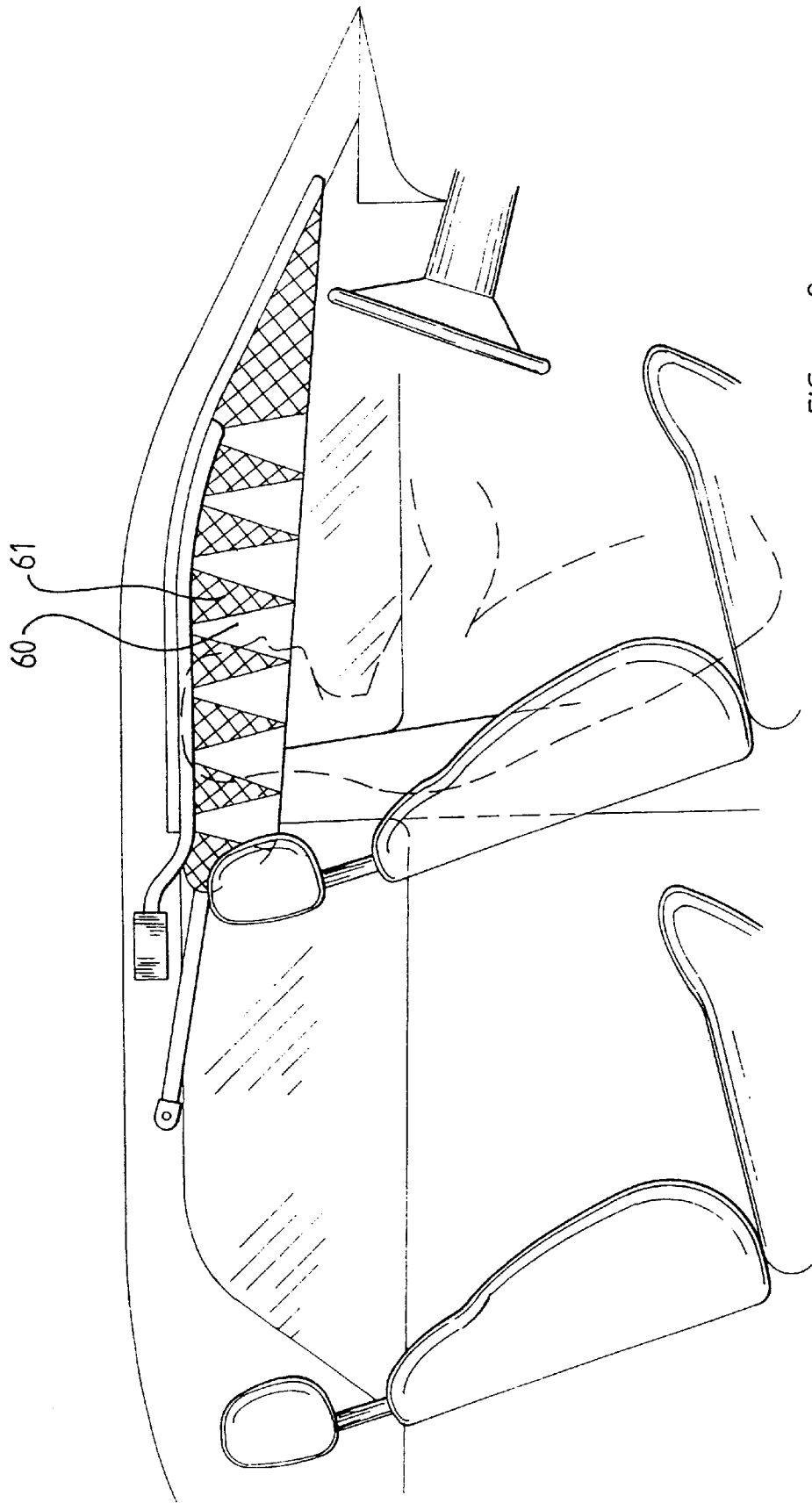


FIG. 9

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SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 09/964,573 filed Sep. 28, 2001, now U.S. Pat. No. 6,494,480, which is a continuation of U.S. application Ser. No. 09/589,402 filed Jun. 8, 2000, now U.S. Pat. No. 6,312,009, which is a continuation of U.S. application Ser. No. 09/127,918, filed Aug. 3, 1998, now U.S. Pat. No. 6,099,029, which is a continuation of U.S. application Ser. No. 08/604,052, filed Feb. 20, 1996, now U.S. Pat. No. 5,788,274.

FIELD OF THE INVENTION.

THIS INVENTION relates to a safety device, and more particularly relates to a safety device in a motor vehicle such as a motor car.

BACKGROUND OF THE INVENTION

When a motor vehicle is involved in an accident there is a risk that the driver and passengers within the vehicle will be injured. It has been proposed to provide vehicles with safety devices to reduce the risk of such injury.

Certain safety devices are intended to provide protection in the case of a side impact. U.S. Pat. No. 5,322,322 discloses such a device. An inflatable tube is initially stored in a recess in the door frame above the door of the vehicle, and the ends of the tube are pivotally anchored to fixed points on the door frame. A sensor is provided to sense when an accident occurs, and to initiate inflation of the tube. As the tube inflates its length decreases, and it then extends linearly between the two fixed points on the door frame. The inflated tube provides some protection for the head of a person sitting in the vehicle. However, the tube is inflated to a substantial pressure, and thus the head of a person in the vehicle may tend to bounce off the tube. The tube may not cover the whole of the area of the window, and may not even cover the whole of the upper part of the window. There is thus a risk that the head of the person in the vehicle may move past the tube and pass through the window opening. If a car is rolling over this is very undesirable.

SUMMARY OF THE INVENTION

This invention seeks to provide an improved safety device.

According to this invention there is provided a safety device in a motor vehicle, the device comprising a gas generator, incorporating or associated with a sensor adapted to sense a side impact or a roll-over and to activate the gas generator, and an inflatable element connected to the gas generator to be inflated by gas from the gas generator, the inflatable element being made of fabric comprising a first layer to define the front part of the inflatable element, and a second layer to define the back part of the inflatable element, selected parts of the first layer and the second layer being interconnected to define points or lines where the front part and back part of the inflatable element are secured together, the inflatable element incorporating a plurality of substantially parallel elongate cells, the inflatable element having an edge portion secured to part of the door frame of the vehicle, which is non-linear, the inflatable element, when inflated, being positioned adjacent the door contained within the door frame.

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The inflatable element, when inflated, is thus located between the head of a person sitting in the vehicle and an adjacent door. Usually such a door is provided with a window and so the inflated element provides protection from breaking glass from the window, and also prevents the head of the person in the vehicle from striking the window, or from being thrown out through the window, as can happen, particularly with roll-over accidents.

Preferably the safety device is usually initially stored in a recess provided in the doorframe.

Preferably the inflatable element is made of interwoven fabric layers, the selected parts of the first layer and the second layer being interwoven. Preferably there is internal venting between the cells as this may reduce undesirable bounce that might occur if the cells were discrete and not vented to each other.

The cells may be immediately adjacent each other or may be spaced apart. At least some of the cells may be of conical form when inflated.

The inflatable element may be formed of a fabric with parts of the fabric being interwoven to form the cell or cells. The fabric may have a single layer weight of less than 300 g/sq m, such as a weight of 175 g/sq m.

Preferably when the inflatable element is inflated the pressure of gas is approximately 3 bar. Preferably the inflatable element, when inflated, extends past the B-post of the vehicle, to provide protection for the head of the driver. If the head of the driver should impact with the B-post in an accident the consequences could be fatal.

In one embodiment the inflatable element incorporates a strap to connect part of the inflatable element to the door frame. The strap is tight, that is, tensioned to a significant extent, when the inflatable element is inflated.

Separate means may be provided to apply tension to part of the inflatable element when it is inflated, such as a piston and cylinder, adapted to be moved by gas from a gas generator when the inflatable element is inflated, to apply tension to one edge of the inflatable element, to hold the inflated element in a desired position.

In one embodiment the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain the means in the further position. Thus, a slider may be provided adapted to slide along a ratchet, and to be retained by the ratchet when it has moved to a further position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which

FIG. 1 is a side view of the interior of a motor vehicle illustrating a safety device in accordance with the invention in an operative state,

FIG. 2 is a side view of part of the interior of a motor vehicle illustrating another safety device in accordance with the invention in the operative state,

FIG. 3 is a sectional view of part of the embodiment of FIG. 2, in a plane perpendicular to a longitudinal axis of the vehicle.

FIG. 4 is a view of part of FIG. 2 showing an additional component of the safety device,

FIG. 5 is a side view of the interior of a motor vehicle provided with another form of safety device in accordance

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with the invention, before the safety device moves to the operative state,

FIG. 6 illustrates the vehicle of FIG. 5 when the safety device is in the operative state,

FIG. 7 is a sectional view of one form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, in a plane perpendicular to the vertical direction.

FIG. 8 is a sectional view of another form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, and

FIG. 9 is a view of part of an alternative inflatable element for use in the embodiments of FIGS. 1, 5 and 6.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 1 a safety device is illustrated which is intended to provide protection for a person 1 sitting in a seat 2 in the vehicle. In any accident in which the vehicle is decelerated the person will tend to move forwardly towards the steering wheel 3, but will be restrained by a conventional seat belt or airbag. In the case of a side impact or roll-over, there is a risk that the head of the person 1 will strike the window in the door beside the person, or strike the B-post. There is also a risk that if, as most commonly happens, the glass in the window should break, the head of the person 1 may be thrown out of the window, especially in the case of roll-over.

The safety device shown in the operative state in FIG. 1 is initially retained in a recess provided in the door frame 4 located above the door of the vehicle. The recess extends over more than simply a linear portion of the door frame so that the two ends of the recess are not in alignment with the main part of the recess.

The safety device comprises a gas generator 5, which is adapted to generate gas, such as cold gas. The gas generator incorporates, or is associated with, a sensor which senses a side impact and/or a roll-over situation to activate the gas generator at an appropriate instant. The gas generator is connected by a hose 6 to a duct 7. The duct 7 forms part of an inflatable element. The inflatable element incorporates a plurality of parallel substantially vertical, substantially cylindrical cells 8. The inflatable element may be made of interwoven fabric. Such a fabric comprises a first layer that defines the front of the inflatable element—that is to say the part that is visible in FIG. 1—and a second layer that defines the back part—that is to say the part that is adjacent the window in FIG. 1—selected parts of the first region and the second region being interwoven to define links in the form of points or lines where the front part and the back part of the inflatable element are secured together. A technique for making an inflatable element of interwoven fabric is described in more detail in International Patent Publication WO 90/09295.

A webbing strap 9 that forms part of the inflatable element extends from the end of the inflatable element near the duct 7 which is connected to the hose 6 to an anchoring point 10 on the door frame 4. The edge of the duct 7 between the points 11, adjacent the top of the B-post 12, and 13, at the lower part of the A-post, in the region of the dashboard 14, is fixed securely to the door frame 4. Consequently, it is to be understood that the upper edge of the inflatable element has a non-linear configuration which conforms with the non-linear configuration of the upper part of the door frame 4 by virtue of the inflatable element being secured, at an upper edge portion thereof, to the door frame all along a non-linear part of the door frame as shown in the figures. A substantial part, in fact virtually all, of the upper edge of the inflatable element is secured to the upper part of the door frame.

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When an accident such as side impact occurs the gas generator generates cold gas which passes through the hose 6 to the duct 7, and then inflates the cells 8. The inflatable element thus moves from its initial stored position within the recess in the door frame to the operative position shown in FIG. 1. The inflatable element then extends downwardly from the top of the door frame to form a flat structure located between the head of the person 1 and the adjacent window. As the cylindrical cells inflate the length of the lower edge 15 of the inflatable element is reduced, and thus the lower edge, together with the webbing strap 9 extend substantially tightly from the point 10 to the point 13. It is to be noted that the part of the door frame 4 between the points 10 and 13 is not linear, and defines, with the linear lower edge of the inflated element, a triangular area which is covered by the inflated element.

The lower edge of the inflated element decreases by about 10% between the uninflated state and the inflated state. The inflated element is fully inflated within about 15 ms. The total thickness of the inflated element, when inflated is approximately 30–40 mm. The seams of interweaving of the front part and the back part of the inflated element are approximately 30–40 mm apart, so that the resultant cells are cylindrical when inflated. The total volume of gas within the inflated element may be between 7 and 9 liters, and the gas may be at a pressure of about 3 bar. While the inflated element is not provided with a vent to vent gas from within the element to the atmosphere, so that the inflated element, when inflated, remains inflated for a long period of time—to provide protection in the case of a protracted roll-over—there is venting between at least selected adjacent cells 8, to avoid any severe rebound. Thus if the head of the person in the vehicle impacts with the inflated element the pressure of gas within the whole element, or at least a substantial part of the element will rise, thus giving a “soft” impact. If each cell were sealed with no venting of this type, there would be a risk of severe rebound.

The weight of the fabric should be kept to be as low as possible, so that if the inflatable element should impact with the head of the person in the vehicle as the inflatable element is inflated no harm will be done. It is thought that a material having a weight of less than 300 g/sq m, such as 175 g/sq m may be used.

It is to be noted that part of the inflated element extends rearwardly beyond the point 11, and is thus located between the head of the person 1 and the top of the B-post. Thus, the risk of the head of the person impacting with the B-post is minimized. Since the upper edge of the inflatable element is secured to the upper part of the door frame along substantially the whole of its length, there is virtually no risk that the head of the occupant will pass between the upper edge of the inflatable element and the upper part of the door frame, with the head of the occupant of the vehicle thus inadvertently emerging from the body shell of the vehicle.

FIGS. 2 to 4 illustrate a second embodiment of the invention. In this embodiment an inflatable element 20 is provided which is initially stored in a recess provided in the door frame 21 of a motor vehicle. A gas generator 22 is provided, which again incorporates or is associated with a sensor or detector which activates the gas generator at an appropriate time. The gas generator is connected by a duct 23 to an inflatable part 24 of the inflatable element 20. The gas generator 22 is located in the door frame 21 of the vehicle, but alternatively could be positioned in the B-post.

The inflatable part 24 or the inflatable section of the inflatable element 20 is formed from two layers of fabric, as

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in the embodiment of FIG. 1, with the front layer and the back layer of the fabric being woven together at selected points 25. The selected points 25 are arranged in vertically extending columns and serve to divide the inflatable part 24 into a plurality of vertical parallel chambers. The spaces between the selected points 25 permit internal venting between adjacent chambers.

The inflatable part 24 of the inflatable element 20 is adapted to be located adjacent the head of an occupant of the motor vehicle, and, towards the rear of the inflatable element, when in the position illustrated in FIG. 2, the inflatable part of the inflatable element extends from the top to the bottom of the inflatable element in a rear region and subsequently, the upper edge of the inflatable part extends downwardly towards the lower edge of the inflatable element, in a sense directed towards the A-Post 26. The remaining part or non-inflatable section of the inflatable element comprises a web or sheet 27 which extends from the inflatable part 24 to the part of the door frame 21 above the door and to the A-post. The web or sheet 27 is thus secured to parts of the door frame that are non-linear. It is to be appreciated, therefore, that in this embodiment of the invention the upper edge of the inflatable element is of non-linear form and is of the same configuration as the non-linear part of the door frame which extends forwardly from the B-post and which incorporates the A-post. The upper edge of the inflatable element, or at least a substantial part of the upper edge, is securely fixed to the upper part of the door frame, thus again minimizing any risk of the head of the occupant emerging from the body shell between the upper edge of the inflatable element and the upper part of the door frame.

Referring to FIG. 3 the edge of the sheet 27 that is secured to the door frame 21 may terminate with a bead 28 that is received within a slot 29 formed in the door frame, the mouth of the slot being narrower than the base so that the bead 28 can slide axially within the slot, but cannot escape from the slot A cable 30 is connected to the end of the bead, as can be seen in FIG. 4, the cable being connected to a tensioning device 31. The tensioning device may comprise a piston in a cylinder associated with a gas generator to generate gas which moves the piston within the cylinder to apply tension to the cable 30 and thus to the bead 28. A ratchet or the like may hold the piston in place when it has been moved by the gas. The gas generator that supplies gas to the piston may be the gas generator 22 or may be a separate gas generator that is triggered simultaneously with the main gas generator

When an accident occurs, the inflatable element 20 moves from its stored position to the operative position shown in FIG. 2, and tension is applied to the inflatable element 20 by the distention of the inflatable part 24, and by the tension applied to the bead 28. The inflated element 20 is thus held firmly in position to provide protection for the head of the person sitting in the motor vehicle. The thickness of the element 20 and the weight of the material used should be as described with reference to the embodiment of FIG. 1.

FIGS. 5 and 6 illustrate another embodiment of the invention intended to provide protection not only for a person in the front seat of a motor vehicle such as a motor car, but also for a person in the rear seat of the vehicle.

Referring to FIG. 5, a recess 40 is provided in the doorframe 41 of a motor vehicle, the recess extending over both the front door 42 and the rear door 43. The recess extends from a point 44 located near the lower end of the A-post to a point 45 located near the lower end of the C-post.

A channel 46 is provided on the B-post, extending vertically. In the channel 46 is a ratchet R, and received within

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the upper end of the channel 46 is a ratchet engaging slide member 47. The slide member 47 is connected to a tab 48 which forms part of an inflatable element 49 (see FIG. 6), which is initially stored within the recess 40.

The inflatable element 49 is shown in the inflated state in FIG. 6. The inflatable element has its top edge 50 secured to the part of the door frame 41 that extends above the doors 42, 43 of the motor vehicle. The top edge of the inflatable element is of non-linear configuration, and has a configuration which corresponds with the non-linear configuration of the upper part of the door frame. The design of the inflatable element is similar to that shown in FIG. 1, with the inflatable element presenting a plurality of parallel cells, which when inflated are substantially cylindrical. The structure of the inflatable element 49 may be the same as that described with reference to FIG. 1.

A gas generator 51 is provided which is connected to the inflatable element in such a way that when the gas generator is activated by a sensor that is formed integrally with the gas generator, or which is associated with the gas generator, and which responds to a side impact or to a roll-over situation to activate the gas generator, gas is initially supplied to the cells 52, 53, which are aligned with the tab 48. Thus initially, as the inflatable element 49 inflates, the cells 52 and 53 inflate and move the ratchet engaging slide member 47 downwardly. The ratchet engaging slide member thus moves down the slot 46 to the position shown in FIG. 6. The ratchet engaging slide member 47 engages the ratchet, and thus holds the tab 48 in its lower position.

The rest of the cells 54 of the inflatable element are then inflated, and the inflatable element then extends fully across the upper parts of the windows in the doors 42, 43 of the motor vehicle. It can be seen that the lower edge of the inflated element 49 extends between the points 44 and 45 at the ends of the recess 40. As the inflatable element 49 inflates, so the length of the lower edge thereof decreases as a consequence of the inflation of the cells of the inflatable element. This reduction in the length of the lower edge, together with the action of the ratchet engaging slide member 47 ensures that the inflated element is retained in position as illustrated after it has been inflated.

FIG. 7 is a cross section showing the nature of the cells of the inflated element of FIG. 1 and of FIGS. 5 and 6. It can be seen that the cells are immediately adjacent to each other and are only separated by narrow regions where the fabric forming the front part of the inflated element has been woven with the fabric forming the back part of the inflated element. However, FIG. 8 illustrates an alternative possibility, in which the regions of fabric between the cells that are woven together are relatively wide, the cells thus being separated by webs of fabric. The advantage of this latter possibility is that a smaller volume of gas may be required to fully inflate the inflatable element, meaning that the inflatable element may be inflated more rapidly.

FIG. 9 illustrated an alternative form of inflatable element comprising a plurality of cells 60 or inflatable sections. The upper edge of the inflatable element is of non-linear form and is connected to the non-linear portion of the door frame above the door. The configuration of the upper edge of the inflatable element and the configuration of the door frame correspond. It can be seen that each cell 60 is of substantially conical form, the cells being arranged adjacent each other and being parallel with each other. Between the cells are inverted triangular portions 61 or non-inflatable sections where the fabric forming the cells is interwoven.

When cells of this type are inflated, the length of the lower edge of the arrangement contracts, whereas the length of the upper edge of the arrangement remains constant.

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An arrangement of this type can be used, therefore, to ensure that the lower edge of the element, when inflated, is under some tension.

Whilst in the arrangement illustrated in FIG. 9, the cells are immediately adjacent each other, it is to be appreciated that a similar effect may be achieved if the cells are spaced 5 apart. It is possible to replace at least part of the inverted triangular region 61 with further conical cells of an inverted orientation.

While in the described embodiments of the invention the inflatable element has been described as being made utilising a technique in which two layers of fabric are interwoven to define points or lines where the front layer and the rear layer are interwoven, it would be possible to form embodiments of the invention utilising two discrete layers of fabric 10 which are interconnected by stitching.

What is claimed is:

1. A safety device in a motor vehicle having a door frame with a front door and a rear door comprising:

a gas generator;

a sensor associated with said gas generator for sensing at least one of a side impact and a roll-over to activate said gas generator; and

an inflatable element connected to said gas generator to be 25 inflated by gas from said gas generator upon activation of said gas generator, said inflatable element having an upper edge portion with a duct through which the gas flows and comprising a first layer of fabric and a second layer of fabric where selected parts of the first layer and the second layer are interconnected to define one of 30 points and lines so that the first and second layers of

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said inflatable element are secured together forming elongated cells;

where the upper edge portion of said inflatable element is secured from a first end to a second end at selected points to a non-linear part of the door frame, which extends over both the front and rear doors, and

where said gas generator is positioned between the first and second ends of said upper edge portion of said inflatable element.

2. A safety device according to claim 1, wherein said gas generator is located substantially in the center of said upper edge portion of said inflatable element.

3. A safety device according to claim 1, wherein the duct of said upper edge portion is arranged so that gas is initially supplied to elongated cells substantially in the center of said inflatable element after said sensor activates said gas generator thereby inflating the center elongated cells first. 15

4. A safety device according to claim 1, wherein the one of points and lines interconnecting the first and second layers of said inflatable element form adjacent elongated cells separated by narrow regions. 20

5. A safety device according to claim 1, wherein the one of points and lines interconnecting the first and second layers of said inflatable element form elongated cells separated by webs of fabric. 25

6. A safety device according to claim 1, further comprising an A-post located in front of the front door and a C-post located behind the rear door wherein said inflatable element extends from the A-post to the C-post. 30

* * * * *

Exhibit D

(12) **United States Patent**
Håland et al.

(10) **Patent No.:** **US 6,494,480 B2**
(45) **Date of Patent:** ***Dec. 17, 2002**

(54) **SIDE IMPACT ROLL OVER INFLATABLE
HEAD PROTECTOR**

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Valkenburg**, Macclesfield (GB); **I.
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(SE)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **09/964,573**

(22) Filed: **Sep. 28, 2001**

(65) **Prior Publication Data**

US 2002/0008371 A1 Jan. 24, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/589,402, filed on Jun. 8,
2000, now Pat. No. 6,312,009, which is a continuation of
application No. 09/127,918, filed on Aug. 3, 1998, now Pat.
No. 6,099,029, which is a continuation of application No.
08/604,052, filed on Feb. 20, 1996, now Pat. No. 5,788,270.

(30) **Foreign Application Priority Data**

Feb. 20, 1995 (GB) 9503267

(51) **Int. Cl.**⁷ **B60R 21/22**; B60R 21/24

(52) **U.S. Cl.** **280/729**; 280/730.2

(58) **Field of Search** 280/730.2, 730.1,
280/729, 743.1, 743.2, 728.1, 753, 749

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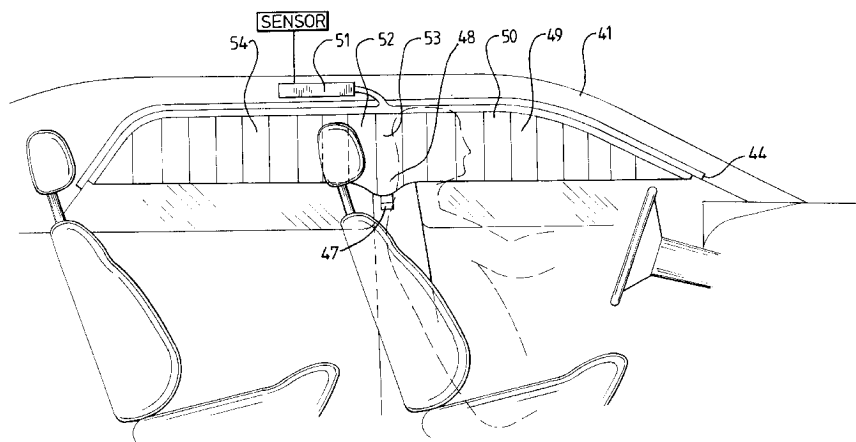
Primary Examiner—Peter C. English

(74) *Attorney, Agent, or Firm*—Venable; Catherine M.
Voorhees

(57) **ABSTRACT**

A safety device for a motor vehicle which has a door frame
and a door contained within the door frame. The safety
device includes: a gas generator; a sensor for sensing at least
one of a side impact and a roll-over for activating the gas
generator; and an inflatable element connected to the gas
generator for being inflated with gas from the gas generator
upon activation of the gas generator. The inflatable element
can thus assume a non-inflated mode and an inflated mode
and can further be positioned adjacent the door in an
inflated-mode thereof. The inflatable element is further made
of fabric and includes: a first fabric layer defining a front part
thereof, a second fabric layer defining a back part thereof,
selected parts of the first fabric layer and second fabric layer
being interconnected for defining one of linear and point
shaped links where the first fabric layer and the second
fabric layer are directly secured together. The inflatable
element thus incorporates a plurality of substantially parallel
elongated cells defined between the links, the cells being
configured such that, upon inflation of the inflatable element
with the gas from the gas generator, a lower edge portion of
the inflatable element is tensioned. The inflatable element
further includes an upper edge portion which is configured
to be secured to the door frame all along a non-linear part of
the door frame.

17 Claims, 5 Drawing Sheets



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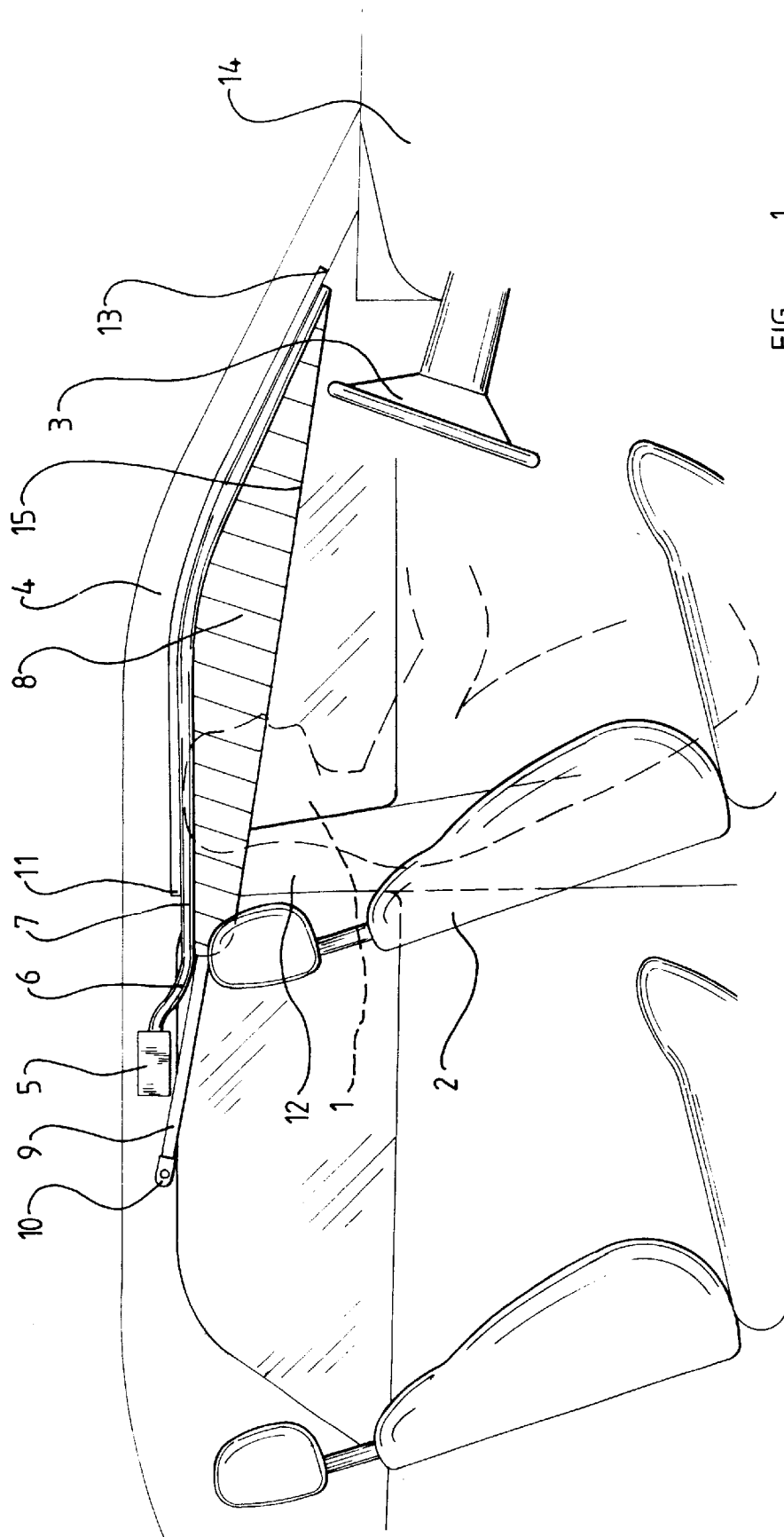
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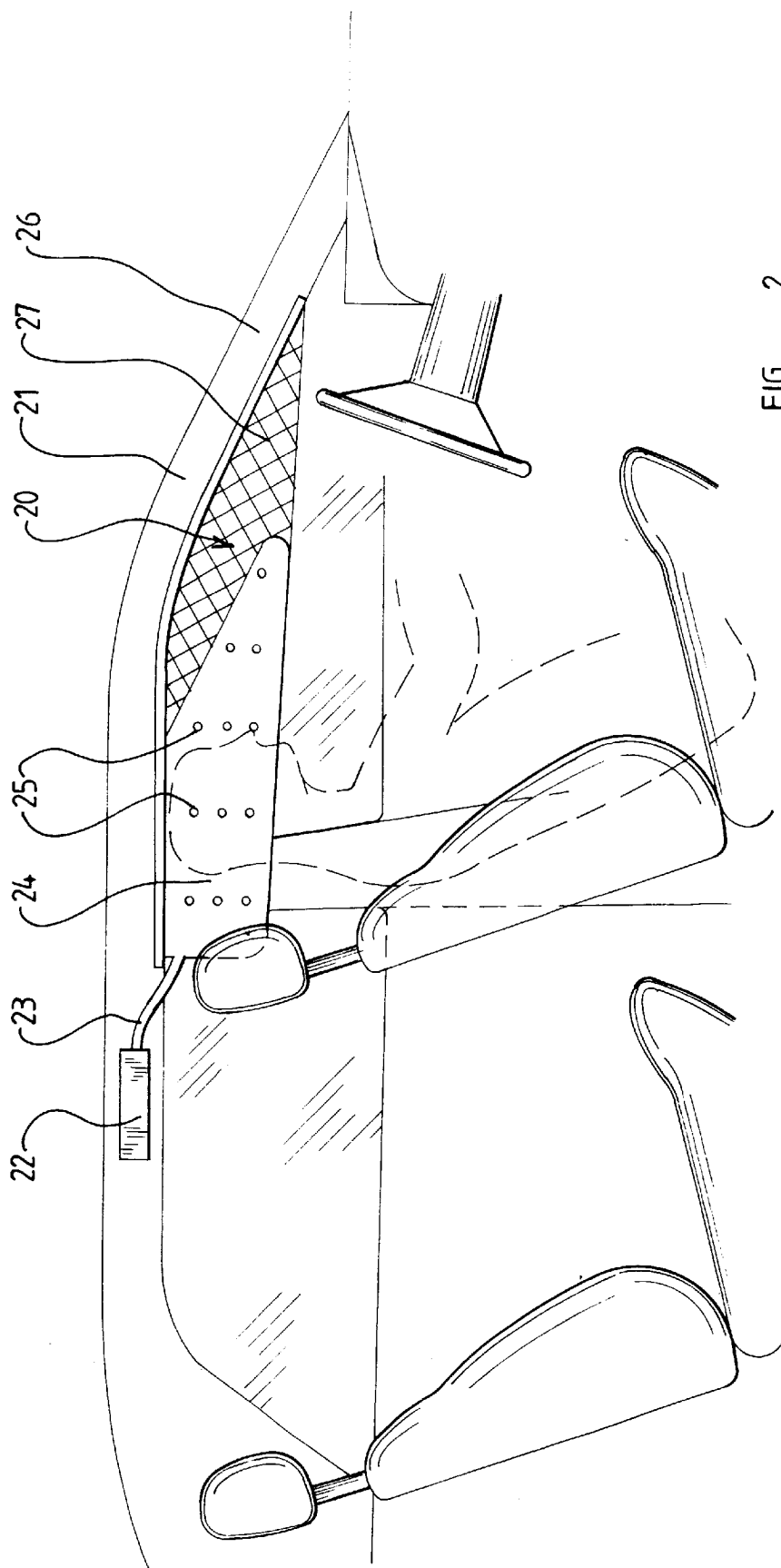


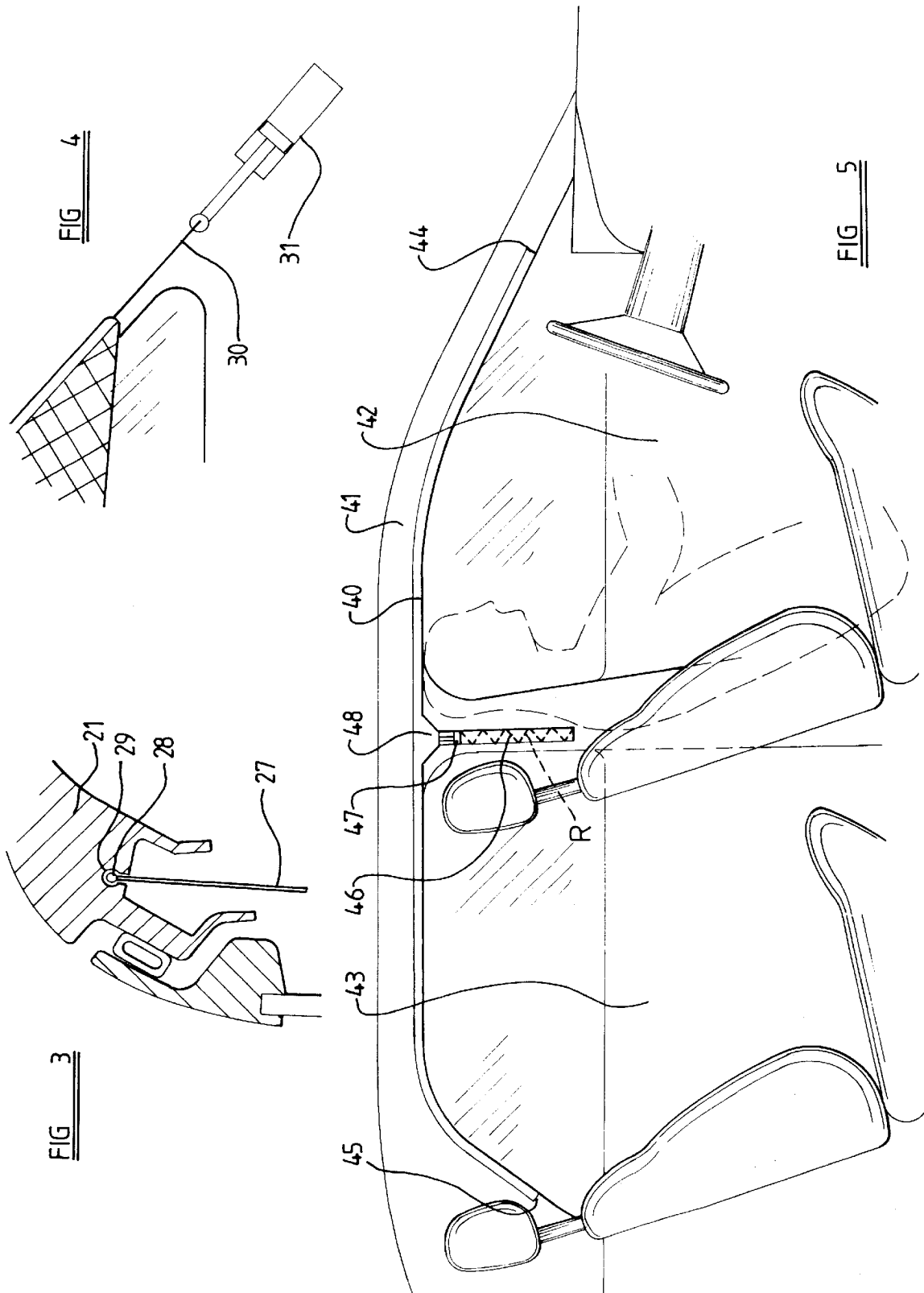
FIG. 2

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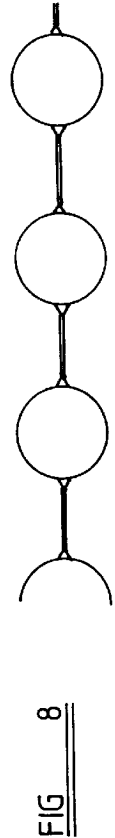


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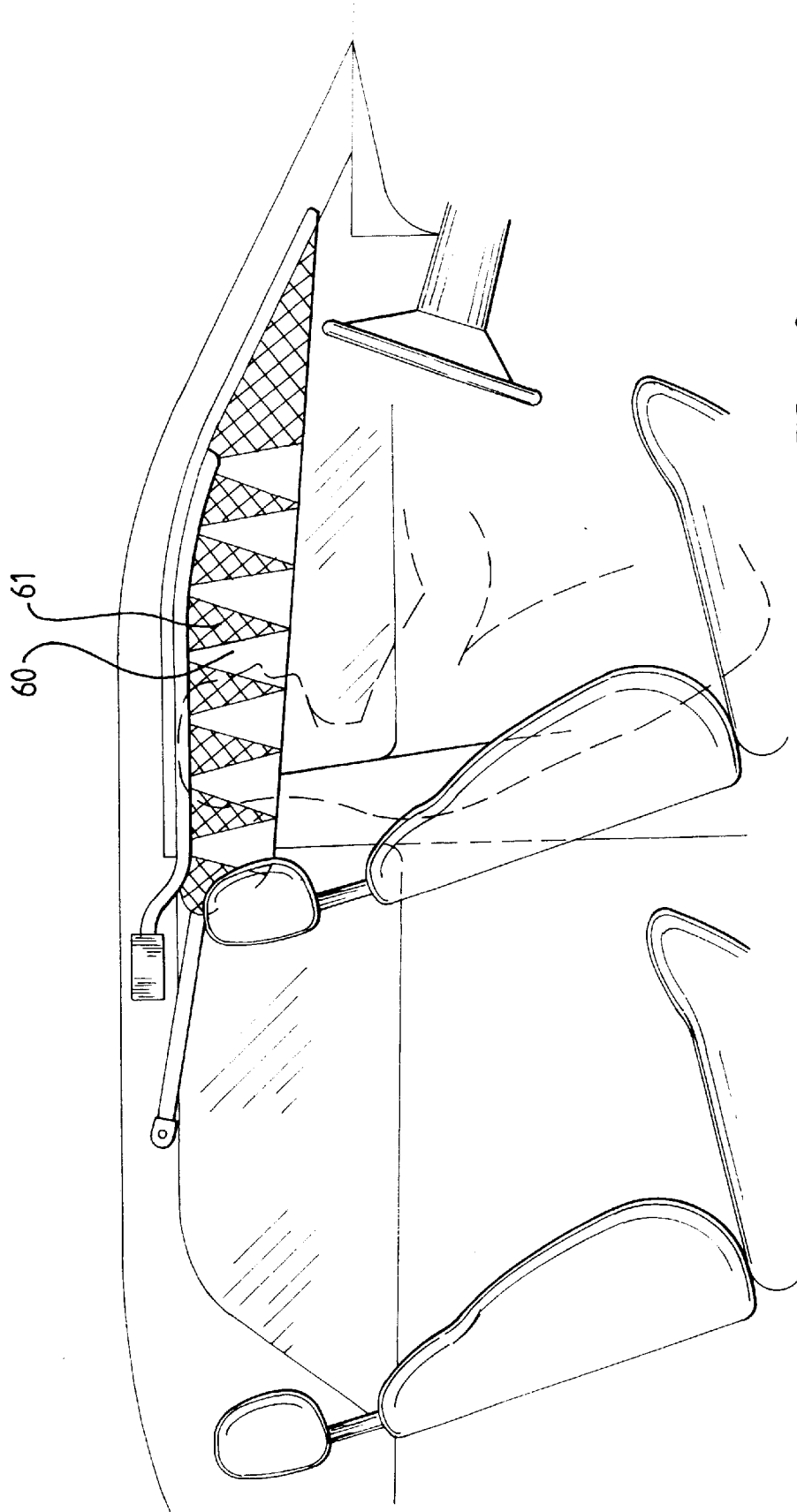


FIG 9

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SIDE IMPACT ROLL OVER INFLATABLE HEAD PROTECTOR

SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR

This application is a continuation of U.S. application Ser. No. 09/589,402 filed Jun. 8, 2000, now U.S. Pat. No. 6,312,009 which is a continuation of U.S. application Ser. No. 09/127, 918, filed Aug. 3, 1998, now U.S. Pat. No. 6,099,029 which is a continuation of U.S. application Ser. No. 08/604,052, filed Feb. 20, 1996, now U.S. Pat. No. 5,788,270.

FIELD OF THE INVENTION

THIS INVENTION relates to a safety device, and more particularly relates to a safety device in a motor vehicle such as a motor car.

BACKGROUND OF THE INVENTION

When a motor vehicle is involved in an accident there is a risk that the driver and passengers within the vehicle will be injured. It has been proposed to provide vehicles with safety devices to reduce the risk of such injury.

Certain safety devices are intended to provide protection in the case of a side impact. U.S. Pat. No. 5,322,322 discloses such a device. An inflatable tube is initially stored in a recess in the door frame above the door of the vehicle, and the ends of the tube are pivotally anchored to fixed points on the door frame. A sensor is provided to sense when an accident occurs, and to initiate inflation of the tube. As the tube inflates its length decreases, and it then extends linearly between the two fixed points on the door frame. The inflated tube provides some protection for the head of a person sitting in the vehicle. However, the tube is inflated to a substantial pressure, and thus the head of a person in the vehicle may tend to bounce off the tube. The tube may not cover the whole of the area of the window, and may not even cover the whole of the upper part of the window. There is thus a risk that the head of the person in the vehicle may move past the tube and pass through the window opening. If a car is rolling over this is very undesirable.

SUMMARY OF THE INVENTION

This invention seeks to provide an improved safety device.

According to this invention there is provided a safety device in a motor vehicle, the device comprising a gas generator, incorporating or associated with a sensor adapted to sense a side impact or a roll-over and to activate the gas generator, and an inflatable element connected to the gas generator to be inflated by gas from the gas generator, the inflatable element being made of fabric comprising a first layer to define the front part of the inflatable element, and a second layer to define the back part of the inflatable element, selected parts of the first layer and the second layer being interconnected to define points or lines where the front part and back part of the inflatable element are secured together, the inflatable element incorporating a plurality of substantially parallel elongate cells, the inflatable element having an edge portion secured to part of the door frame of the vehicle, which is non-linear, the inflatable element, when inflated, being positioned adjacent the door contained within the door frame.

The inflatable element, when inflated, is thus located between the head of a person sitting in the vehicle and an

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adjacent door. Usually such a door is provided with a window and so the inflated element provides protection from breaking glass from the window, and also prevents the head of the person in the vehicle from striking the window, or from being thrown out through the window, as can happen, particularly with roll-over accidents.

Preferably the safety device is usually initially stored in a recess provided in the doorframe.

Preferably the inflatable element is made of interwoven fabric layers, the selected parts of the first layer and the second layer being interwoven. Preferably there is internal venting between the cells as this may reduce undesirable bounce that might occur if the cells were discrete and not vented to each other.

The cells may be immediately adjacent each other or may be spaced apart. At least some of the cells may be of conical form when inflated.

The inflatable element may be formed of a fabric with parts of the fabric being interwoven to form the cell or cells. The fabric may have a single layer weight of less than 300 g/sq m, such as a weight of 175 g/sq m.

Preferably when the inflatable element is inflated the pressure of gas is approximately 3 bar. Preferably the inflatable element, when inflated, extends past the B-post of the vehicle, to provide protection for the head of the driver. If the head of the driver should impact with the B-post in an accident the consequences could be fatal.

In one embodiment the inflatable element incorporates a strap to connect part of the inflatable element to the door frame. The strap is tight, that is, tensioned to a significant extent, when the inflatable element is inflated.

Separate means may be provided to apply tension to part of the inflatable element when it is inflated, such as a piston and cylinder, adapted to be moved by gas from a gas generator when the inflatable element is inflated, to apply tension to one edge of the inflatable element, to hold the inflated element in a desired position.

In one embodiment the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain the means in the further position. Thus, a slider may be provided adapted to slide along a ratchet, and to be retained by the ratchet when it has moved to a further position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which

FIG. 1 is a side view of the interior of a motor vehicle illustrating a safety device in accordance with the invention in an operative state,

FIG. 2 is a side view of part of the interior of a motor vehicle illustrating another safety device in accordance with the invention in the operative state,

FIG. 3 is a sectional view of part of the embodiment of FIG. 2, in a plane perpendicular to a longitudinal axis of the vehicle.

FIG. 4 is a view of part of FIG. 2 showing an additional component of the safety device,

FIG. 5 is a side view of the interior of a motor vehicle provided with another form of safety device in accordance with the invention, before the safety device moves to the operative state,

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FIG. 6 illustrates the vehicle of FIG. 5 when the safety device is in the operative state,

FIG. 7 is a sectional view of one form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, in a plane perpendicular to the vertical direction.

FIG. 8 is a sectional view of another form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, and

FIG. 9 is a view of part of an alternative inflatable element for use in the embodiments of FIGS. 1, 5 and 6.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 1 a safety device is illustrated which is intended to provide protection for a person 1 sitting in a seat 2 in the vehicle. In any accident in which the vehicle is decelerated the person will tend to move forwardly towards the steering wheel 3, but will be restrained by a conventional seat belt or air-bag. In the case of a side impact or roll-over, there is a risk that the head of the person 1 will strike the window in the door beside the person, or strike the B-post. There is also a risk that if, as most commonly happens, the glass in the window should break, the head of the person 1 may be thrown out of the window, especially in the case of roll-over.

The safety device shown in the operative state in FIG. 1 is initially retained in a recess provided in the door frame 4 located above the door of the vehicle. The recess extends over more than simply a linear portion of the door frame so that the two ends of the recess are not in alignment with the main part of the recess.

The safety device comprises a gas generator 5, which is adapted to generate gas, such as cold gas. The gas generator incorporates, or is associated with, a sensor which senses a side impact and/or a roll-over situation to activate the gas generator at an appropriate instant. The gas generator is connected by a hose 6 to a duct 7. The duct 7 forms part of an inflatable element. The inflatable element incorporates a plurality of parallel substantially vertical, substantially cylindrical cells 8. The inflatable element may be made of interwoven fabric. Such a fabric comprises a first layer that defines the front of the inflatable element—that is to say the part that is visible in FIG. 1—and a second layer that defines the back part—that is to say the part that is adjacent the window in FIG. 1—selected parts of the first region and the second region being interwoven to define links in the form of points or lines where the front part and the back part of the inflatable element are secured together. A technique for making an inflatable element of interwoven fabric is described in more detail in International Patent Publication WO 90/09295.

A webbing strap 9 that forms part of the inflatable element extends from the end of the inflatable element near the duct 7 which is connected to the hose 6 to an anchoring point 10 on the door frame 4. The edge of the duct 7 between the points 11, adjacent the top of the B-post 12, and 13, at the lower part of the A-post, in the region of the dashboard 14, is fixed securely to the door frame 4. Consequently, it is to be understood that the upper edge of the inflatable element has a non-linear configuration which conforms with the non-linear configuration of the upper part of the door frame 4 by virtue of the inflatable element being secured, at an upper edge portion thereof, to the door frame all along a non-linear part of the door frame as shown in the figures. A substantial part, in fact virtually all, of the upper edge of the inflatable element is secured to the upper part of the door frame.

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When an accident such as side impact occurs the gas generator generates cold gas which passes through the hose 6 to the duct 7, and then inflates the cells 8. The inflatable element thus moves from its initial stored position within the recess in the door frame to the operative position shown in FIG. 1. The inflatable element then extends downwardly from the top of the door frame to form a flat structure located between the head of the person 1 and the adjacent window. As the cylindrical cells inflate the length of the lower edge 15 of the inflatable element is reduced, and thus the lower edge, together with the webbing strap 9 extend substantially tightly from the point 10 to the point 13. It is to be noted that the part of the door frame 4 between the points 10 and 13 is not linear, and defines, with the linear lower edge of the inflated element, a triangular area which is covered by the inflated element.

The lower edge of the inflated element decreases by about 10% between the uninflated state and the inflated state. The inflated element is fully inflated within about 15 ms. The total thickness of the inflated element, when inflated is approximately 30–40 mm. The seams of interweaving of the front part and the back part of the inflated element are approximately 30–40 mm apart, so that the resultant cells are cylindrical when inflated. The total volume of gas within the inflated element may be between 7 and 9 liters, and the gas may be at a pressure of about 3 bar. While the inflated element is not provided with a vent to vent gas from within the element to the atmosphere, so that the inflated element, when inflated, remains inflated for a long period of time—to provide protection in the case of a protracted roll-over—there is venting between at least selected adjacent cells 8, to avoid any severe rebound. Thus if the head of the person in the vehicle impacts with the inflated element the pressure of gas within the whole element, or at least a substantial part of the element will rise, thus giving a “soft” impact. If each cell were sealed with no venting of this type, there would be a risk of severe rebound.

The weight of the fabric should be kept to be as low as possible, so that if the inflatable element should impact with the head of the person in the vehicle as the inflatable element is inflated no harm will be done. It is thought that a material having a weight of less than 300 g/sq m, such as 175 g/sq m may be used.

It is to be noted that part of the inflated element extends rearwardly beyond the point 11, and is thus located between the head of the person 1 and the top of the B-post. Thus the risk of the head of the person impacting with the B-post is minimized. Since the upper edge of the inflatable element is secured to the upper part of the door frame along substantially the whole of its length, there is virtually no risk that the head of the occupant will pass between the upper edge of the inflatable element and the upper part of the door frame, with the head of the occupant of the vehicle thus inadvertently emerging from the body shell of the vehicle.

FIGS. 2 to 4 illustrate a second embodiment of the invention. In this embodiment an inflatable element 20 is provided which is initially stored in a recess provided in the door frame 21 of a motor vehicle. A gas generator 22 is provided, which again incorporates or is associated with a sensor or detector which activates the gas generator at an appropriate time. The gas generator is connected by a duct 23 to an inflatable part 24 of the inflatable element 20. The gas generator 22 is located in the door frame 21 of the vehicle, but alternatively could be positioned in the B-post.

The inflatable part 24 or the inflatable section of the inflatable element 20 is formed from two layers of fabric, as

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in the embodiment of FIG. 1, with the front layer and the back layer of the fabric being woven together at selected points 25. The selected points 25 are arranged in vertically extending columns and serve to divide the inflatable part 24 into a plurality of vertical parallel chambers. The spaces between the selected points 25 permit internal venting between adjacent chambers.

The inflatable part 24 of the inflatable element 20 is adapted to be located adjacent the head of an occupant of the motor vehicle, and, towards the rear of the inflatable element, when in the position illustrated in FIG. 2, the inflatable part of the inflatable element extends from the top to the bottom of the inflatable element in a rear region and subsequently, the upper edge of the inflatable part extends downwardly towards the lower edge of the inflatable element, in a sense directed towards the A-Post 26. The remaining part or non-inflatable inflatable section of the inflatable element comprises a web or sheet 27 which extends from the inflatable part 24 to the part of the door frame 21 above the door and to the A-post. The web or sheet 27 is thus secured to parts of the door frame that are non-linear. It is to be appreciated, therefore, that in this embodiment of the invention the upper edge of the inflatable element is of non-linear form and is of the same configuration as the non-linear part of the door frame which extends forwardly from the B-post and which incorporates the A-post. The upper edge of the inflatable element, or at least a substantial part of the upper edge, is securely fixed to the upper part of the door frame, thus again minimizing any risk of the head of the occupant emerging from the body shell between the upper edge of the inflatable element and the upper part of the door frame.

Referring to FIG. 3 the edge of the sheet 27 that is secured to the door frame 21 may terminate with a bead 28 that is received within a slot 29 formed in the door frame, the mouth of the slot being narrower than the base so that the bead 28 can slide axially within the slot, but cannot escape from the slot. A cable 30 is connected to the end of the bead, as can be seen in FIG. 4, the cable being connected to a tensioning device 31. The tensioning device may comprise a piston in a cylinder associated with a gas generator to generate gas which moves the piston within the cylinder to apply tension to the cable 30 and 42 thus to the bead 28. A ratchet or the like may hold the piston in place when it has been moved by the gas. The gas generator that supplies gas to the piston may be the gas generator 22 or may be a separate gas generator that is triggered simultaneously with the main gas generator.

When an accident occurs the inflatable element 20 moves from its stored position to the operative position shown in FIG. 2, and tension is applied to the inflatable element 20 by the distention of the inflatable part 24, and by the tension applied to the bead 28. The inflated element 20 is thus held firmly in position to provide protection for the head of the person sitting in the motor vehicle. The thickness of the element 20 and the weight of the material used should be as described with reference to the embodiment of FIG. 1.

FIGS. 5 and 6 illustrate another embodiment of the invention intended to provide protection not only for a person in the front seat of a motor vehicle such as a motor car, but also for a person in the rear seat of the vehicle.

Referring to FIG. 5, a recess 40 is provided in the doorframe 41 of a motor vehicle, the recess extending over both the front door 42 and the rear door 43. The recess extends from a point 44 located near the lower end of the A-post to a point 45 located near the lower end of the C-post.

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A channel 46 is provided on the B-post, extending vertically. In the channel 46 is a ratchet R, and received within the upper end of the channel 46 is a ratchet engaging slide member 47. The slide member 47 is connected to a tab 48 which forms part of an inflatable element 49 (see FIG. 6), which is initially stored within the recess 40.

The inflatable element 49 is shown in the inflated state in FIG. 6. The inflatable element has its top edge 50 secured to the part of the door frame 41 that extends above the doors 42, 43 of the motor vehicle. The top edge of the inflatable element is of non-linear configuration, and has a configuration which corresponds with the non-linear configuration of the upper part of the door frame. The design of the inflatable element is similar to that shown in FIG. 1, with the inflatable element presenting a plurality of parallel cells, which when inflated are substantially cylindrical. The structure of the inflatable element 49 may be the same as that described with reference to FIG. 1.

A gas generator 51 is provided which is connected to the inflatable element in such a way that when the gas generator is activated by a sensor that is formed integrally with the gas generator, or which is associated with the gas generator, and which responds to a side impact or to a roll-over situation to activate the gas generator, gas is initially supplied to the cells 52, 53, which are aligned with the tab 48. Thus initially, as the inflatable element 49 inflates, the cells 52 and 53 inflate and move the ratchet engaging slide member 47 downwardly. The ratchet engaging slide member thus moves down the slot 46 to the position shown in FIG. 6. The ratchet engaging slide member 47 engages the ratchet, and thus holds the tab 48 in its lower position.

The rest of the cells 54 of the inflatable element are then inflated, and the inflatable element then extends fully across the upper parts of the windows in the doors 42, 43 of the motor vehicle. It can be seen that the lower edge of the inflated element 49 extends between the points 44 and 45 at the ends of the recess 40. As the inflatable element 49 inflates, so the length of the lower edge thereof decreases as a consequence of the inflation of the cells of the inflatable element. This reduction in the length of the lower edge, together with the action of the ratchet engaging slide member 47 ensures that the inflated element is retained in position as illustrated after it has been inflated.

FIG. 7 is a cross section showing the nature of the cells of the inflated element of FIG. 1 and of FIGS. 5 and 6. It can be seen that the cells are immediately adjacent to each other and are only separated by narrow regions where the fabric forming the front part of the inflated element has been woven with the fabric forming the back part of the inflated element. However, FIG. 8 illustrates an alternative possibility, in which the regions of fabric between the cells that are woven together are relatively wide, the cells thus being separated by webs of fabric. The advantage of this latter possibility is that a smaller volume of gas may be required to fully inflate the inflatable element, meaning that the inflatable element may be inflated more rapidly.

FIG. 9 illustrates form of inflatable element comprising a plurality of cells 60 or inflatable sections. The upper edge of the inflatable element is of non-linear form and is connected to the non-linear portion of the door frame above the door. The configuration of the upper edge of the inflatable element and the configuration of the door frame correspond. It can be seen that each cell 60 is of substantially conical form, the cells being arranged adjacent each other and being parallel with each other. Between the cells are inverted triangular portions 61 or non-inflatable sections where the fabric forming the cells is interwoven.

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When cells of this type are inflated, the length of the lower edge of the arrangement contracts, whereas the length of the upper edge of the arrangement remains constant.

An arrangement of this type can be used, therefore, to ensure that the lower edge of the element, when inflated, is under some tension.

Whilst in the arrangement illustrated in FIG. 9, the cells are immediately adjacent each other, it is to be appreciated that a similar effect may be achieved if the cells are spaced apart. It is possible to replace at least part of the inverted triangular region 61 with further conical cells of an inverted orientation.

Whilst in the described embodiments of the invention the inflatable element has been described as being made utilising a technique in which two layers of fabric are interwoven to define points or lines where the front layer and the rear layer are interwoven, it would be possible to form embodiments of the invention utilising two discrete layers of fabric which are interconnected by stitching.

What is claimed is:

1. A safety device in a motor vehicle having a door frame and front and rear doors contained within the door frame, the safety device comprising:

- a gas generator;
- a sensor associated with said gas generator for sensing one of a side impact and a roll-over and activating said gas generator; and
- an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element comprising:
 - a first layer to define a front part of said inflatable element;
 - a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected to define points where the front part and the back part of said inflatable element are secured together forming elongated cells; and
 - an upper edge portion secured at selected points to a non-linear part of the door frame which extends over both the front door and the rear door, whereby, when inflated, said inflatable element is positioned adjacent the doors contained in the door frame.

2. A safety device according to claim 1, wherein said inflatable element is made of fabric and said first and second layers are first and second fabric layers.

3. A safety device in a motor vehicle having a door frame and front and rear doors contained within the door frame, the safety device comprising:

- a gas generator;
- a sensor associated with said gas generator for sensing one of a side impact and a roll-over and activating said gas generator; and
- an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element comprising:
 - a first layer to define a front part of said inflatable element;
 - a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected to define points where the front part and the back part of said inflatable element are secured together forming substantially vertical cells; and

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an upper edge portion secured at selected points to a non-linear part of the door frame which extends over both the front door and the rear door, whereby, when inflated, said inflatable element is positioned adjacent the doors contained in the door frame.

4. A safety device in a motor vehicle having a door frame with an opening comprising:

- a gas generator;
- a sensor associated with said gas generator for sensing at least one of a side impact and a roll-over that activates said gas generator; and
- an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element comprising:
 - a first layer to define a front part of said inflatable element;
 - a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected to define regions where the front part and the back part of said inflatable element are secured together forming elongated cells which define axes;
 - a lower edge portion having opposed ends, the opposed ends of the lower edge portion being secured to two fixed anchoring points on the vehicle; and

an upper edge portion secured at at least one selected point to a part of the vehicle at a level above the opening within the door frame, where the axes defined by the cells intersect said lower edge portion of the inflatable element, and

whereby, when inflated, said inflatable element is positioned adjacent a window of a door contained in the opening of the frame, and said cells are designed such that on inflation of the inflatable element, the lower edge portion of said inflatable element is tensioned between the two fixed anchoring points.

5. A safety device according to claim 4, wherein the inflatable element, in a non-inflated mode, is initially stored in a recess provided in the door frame.

6. A safety device according to claim 4, wherein said inflatable element is made of fabric and said first and second layers are first and second fabric layers.

7. A safety device according to claim 6, wherein the first fabric layer and the second fabric layer are interconnected at the selected parts thereof by being interwoven with one another at said regions.

8. A safety device according to claim 4, wherein the cells are configured to be in gas flow communication with one another.

9. A safety device according to claim 4, wherein the cells are immediately adjacent each other.

10. A safety device according to claim 4, wherein the cells are spaced apart from each other.

11. A safety device according to claim 4, wherein at least some of the cells have a conical shape when the inflatable element is inflated.

12. A safety device according to claim 4, wherein the inflatable element is made of a fabric having a single layer weight of less than 300 g/sq m.

13. A safety device according to claim 4, wherein, when inflated, the pressure in the inflatable element is approximately 3 bar.

14. A safety device according to claim 4 wherein the inflatable element, when inflated, extends past a B-post of the vehicle.

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15. A safety device according to claim **4**, further comprising a strap connected to a part of the inflatable element and to the door frame.

16. A safety device according to claim **4**, further comprising a tensioning device for applying tension to the inflatable element when it is inflated. 5

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17. The safety device according to claim **4**, wherein the cells are configured to extend substantially. from the upper edge portion of the inflatable element to a lower edge portion of the inflatable element.

* * * * *

Exhibit E

United States Patent [19]
Håland et al.

[11] Patent Number: 6,099,029
[45] Date of Patent: *Aug. 8, 2000

[54] SIDE IMPACT AND ROLL OVER
INFLATABLE HEAD PROTECTOR

5,957,487 9/1999 Stutz 280/730.2

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[*] Notice: This patent issued on a continued pros-
ecution application filed under 37 CFR
1.53(d), and is subject to the twenty year
patent term provisions of 35 U.S.C.
154(a)(2).
This patent is subject to a terminal dis-
claimer.

[21] Appl. No.: 09/127,918

[22] Filed: Aug. 3, 1998

Related U.S. Application Data

[63] Continuation of application No. 08/604,052, Feb. 20, 1996,
Pat. No. 5,788,270.

Foreign Application Priority Data

Feb. 20, 1995 [GB] United Kingdom 9503267

[51] Int. Cl.⁷ B60R 21/22; B60R 21/24

[52] U.S. Cl. 280/729; 280/730.2

[58] Field of Search 280/730.2, 730.1,
280/729, 743.1, 743.2, 728.1, 753, 749

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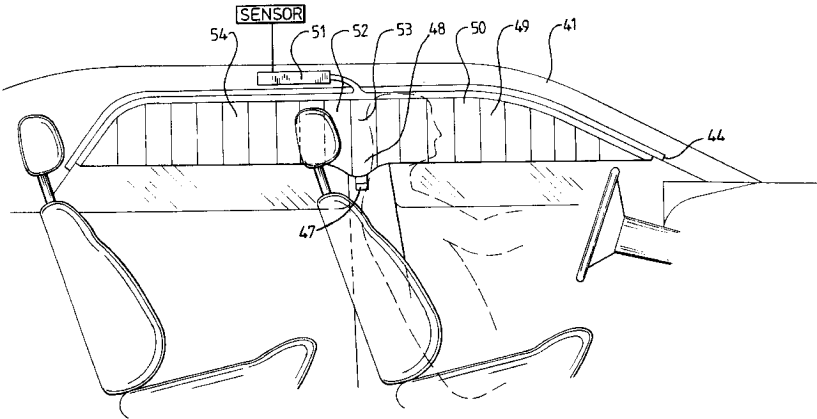
Primary Examiner—Peter C. English

Attorney, Agent, or Firm—Venable; George H. Spencer;
Catherine M. Voorhees

[57] ABSTRACT

A safety device for a motor vehicle which has a door frame and a door contained within the door frame. The safety device includes: a gas generator; a sensor for sensing at least one of a side impact and a roll-over for activating the gas generator; and an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator. The inflatable element can thus assume a non-inflated mode and an inflated mode and can further be positioned adjacent the door in an inflated-mode thereof. The inflatable element is further made of fabric and includes: a first fabric layer defining a front part thereof; a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together. The inflatable element thus incorporates a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned. The inflatable element further includes an upper edge portion which is configured to be secured to the door frame all along a non-linear part of the door frame.

8 Claims, 5 Drawing Sheets

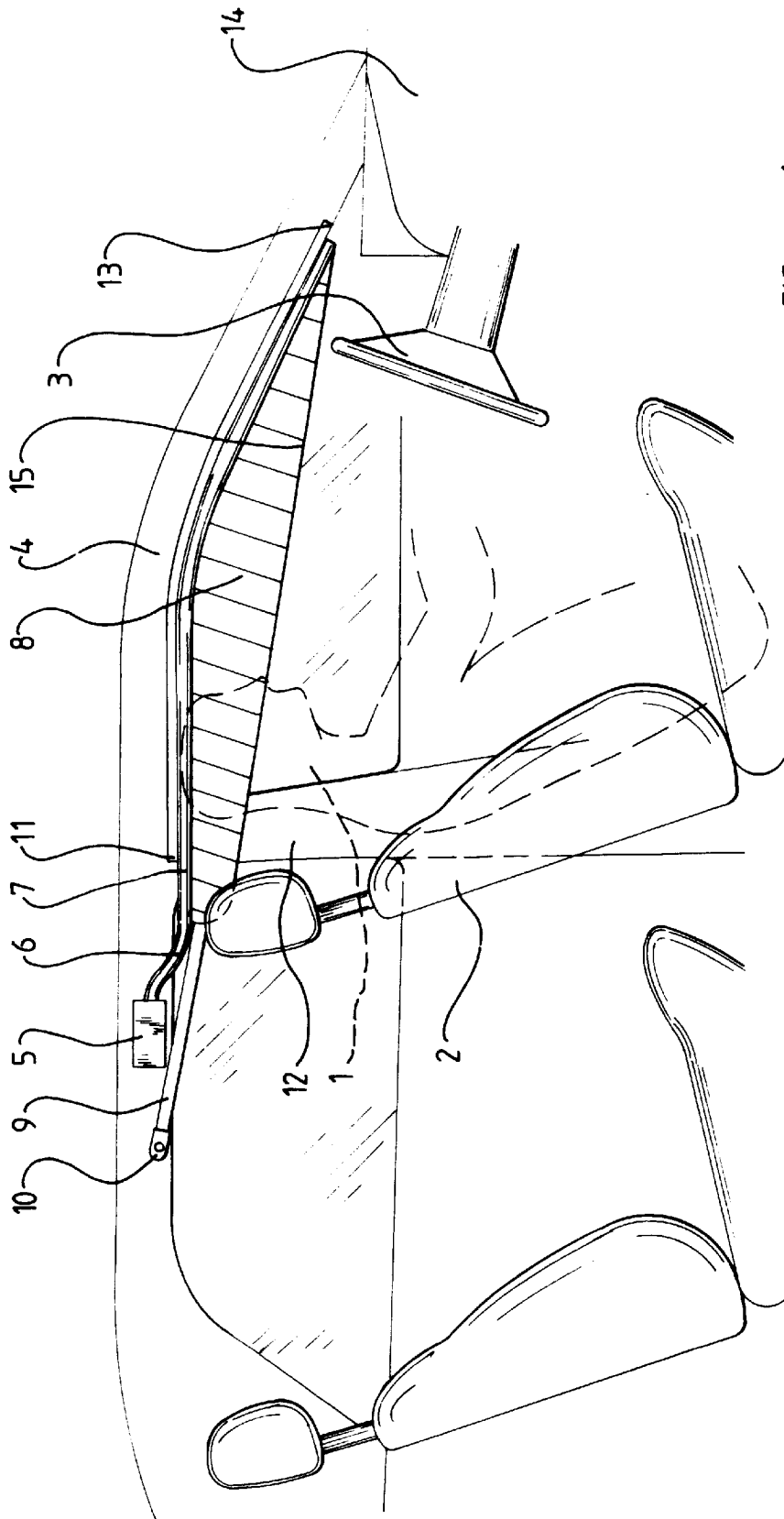


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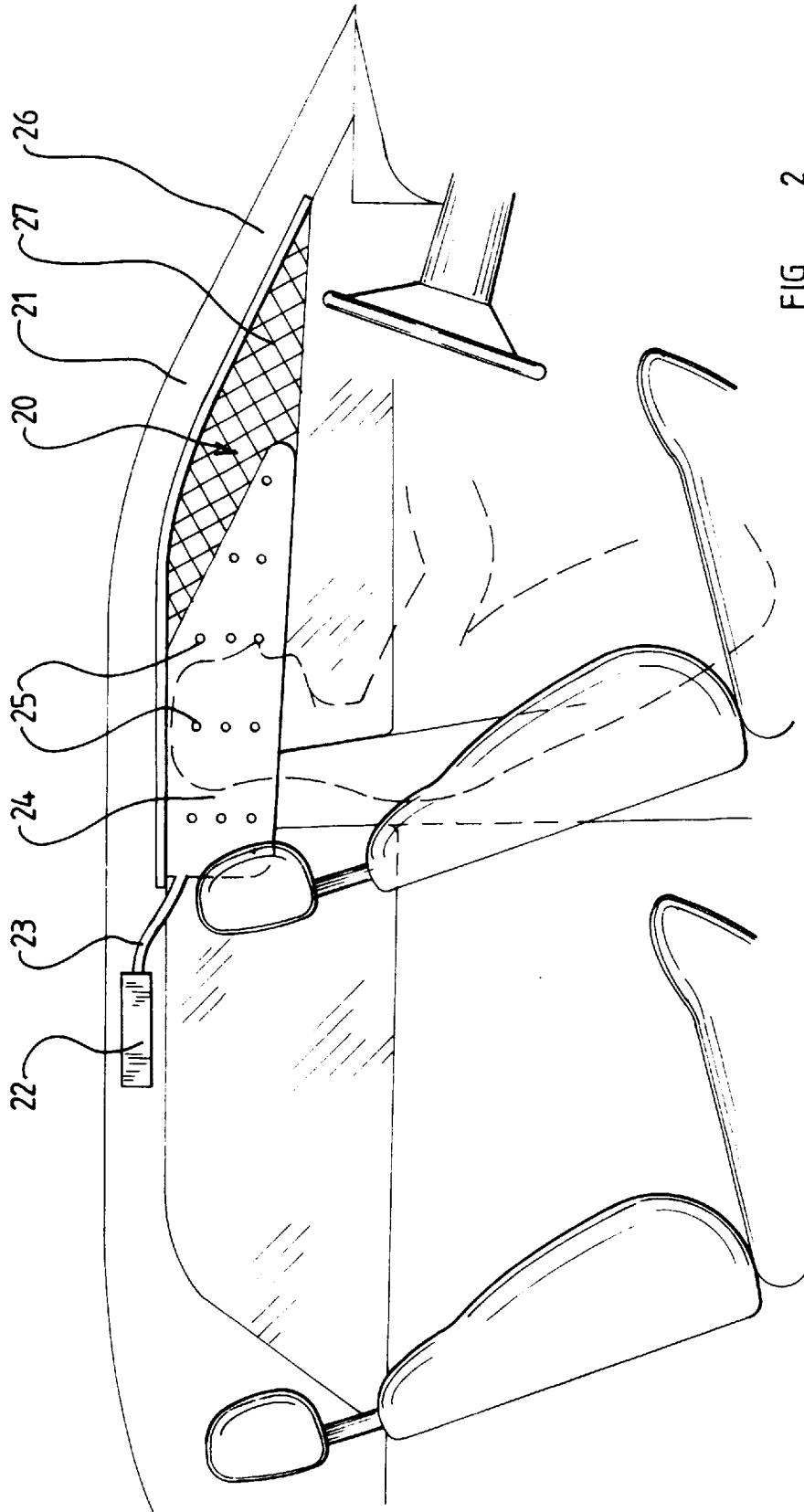


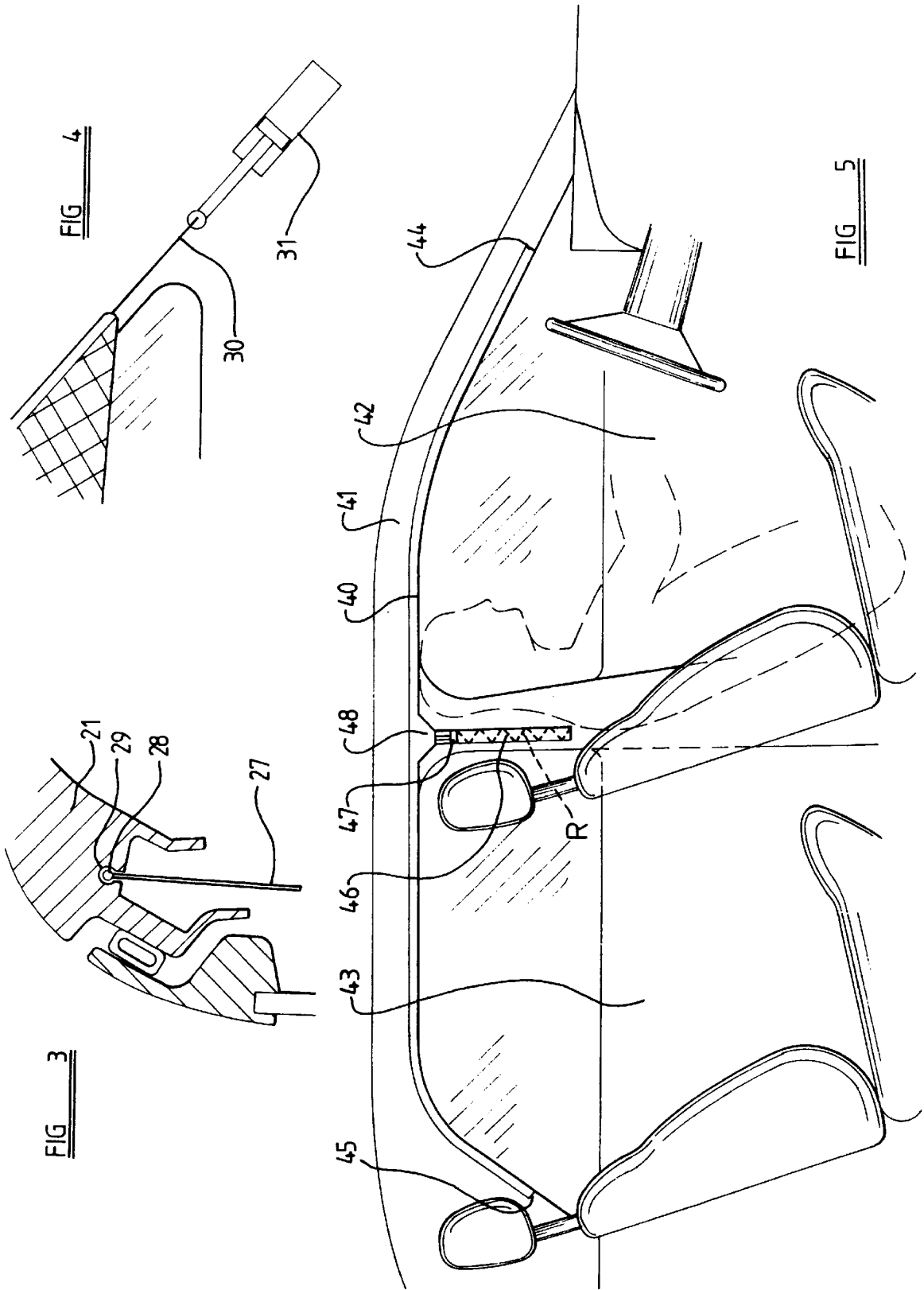
FIG. 2

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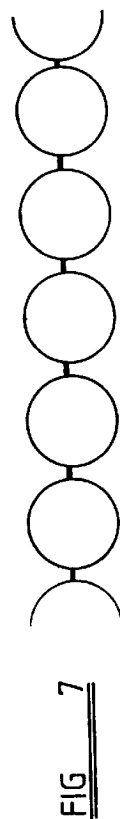
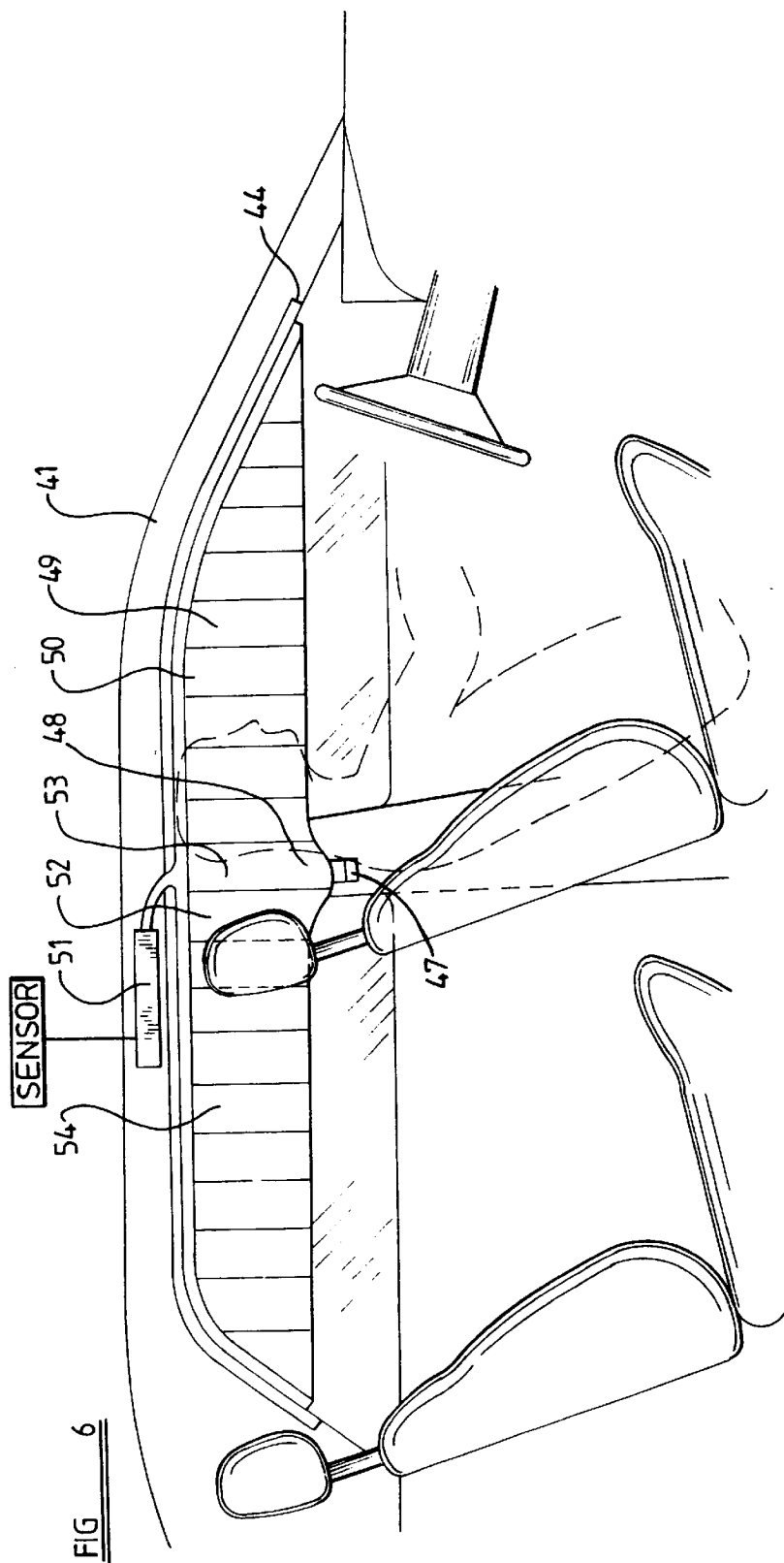


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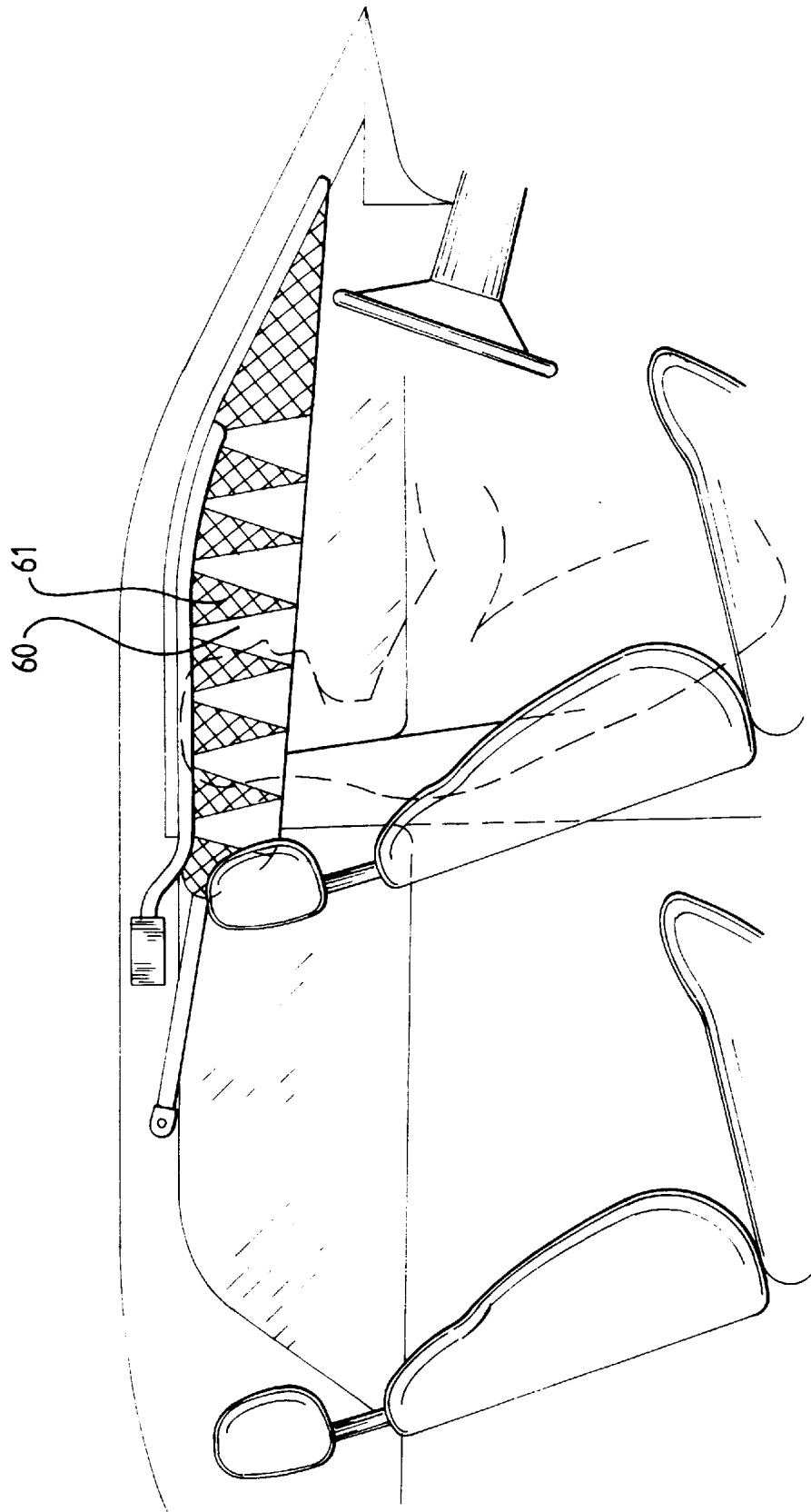


FIG. 9

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SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 08/604,052 filed Feb. 20, 1996 U.S. Pat. No. 5,788,270.

FIELD OF THE INVENTION

THIS INVENTION relates to a safety device, and more particularly relates to a safety device in a motor vehicle such as a motor car.

BACKGROUND OF THE INVENTION

When a motor vehicle is involved in an accident there is a risk that the driver and passengers within the vehicle will be injured. It has been proposed to provide vehicles with safety devices to reduce the risk of such injury.

Certain safety devices are intended to provide protection in the case of a side impact. U.S. Pat. No. 5,322,322 discloses such a device. An inflatable tube is initially stored in a recess in the door frame above the door of the vehicle, and the ends of the tube are pivotally anchored to fixed points on the door frame. A sensor is provided to sense when an accident occurs, and to initiate inflation of the tube. As the tube inflates its length decreases, and it then extends linearly between the two fixed points on the door frame. The inflated tube provides some protection for the head of a person sitting in the vehicle. However, the tube is inflated to a substantial pressure, and thus the head of a person in the vehicle may tend to bounce off the tube. The tube may not cover the whole of the area of the window, and may not even cover the whole of the upper part of the window. There is thus a risk that the head of the person in the vehicle may move past the tube and pass through the window opening. If a car is rolling over this is very undesirable.

SUMMARY OF THE INVENTION

This invention seeks to provide an improved safety device.

According to this invention there is provided a safety device in a motor vehicle, the device comprising a gas generator, incorporating or associated with a sensor adapted to sense a side impact or a roll-over and to activate the gas generator, and an inflatable element connected to the gas generator to be inflated by gas from the gas generator, the inflatable element being made of fabric comprising a first layer to define the front part of the inflatable element, and a second layer to define the back part of the inflatable element, selected parts of the first layer and the second layer being inter-connected to define points or lines where the front part and back part of the inflatable element are secured together, the inflatable element incorporating a plurality of substantially parallel elongate cells, the inflatable element having an edge portion secured to part of the door frame of the vehicle which is non-linear, the inflatable element, when inflated, being positioned adjacent the door contained within the door frame.

The inflatable element, when inflated, is thus located between the head of a person sitting in the vehicle and an adjacent door. Usually such a door is provided with a window and so the inflated element provides protection from breaking glass from the window, and also prevents the head of the person in the vehicle from striking the window, or from being thrown out through the window, as can happen, particularly with roll-over accidents.

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Preferably the safety device is usually initially stored in a recess provided in the doorframe.

Preferably the inflatable element is made of inter-woven fabric layers, the selected parts of the first layer and the second layer being inter-woven. Preferably there is internal venting between the cells as this may reduce undesirable bounce that might occur if the cells were discrete and not vented to each other.

The cells may be immediately adjacent each other or may be spaced apart. At least some of the cells may be of conical form when inflated.

The inflatable element may be formed of a fabric with parts of the fabric being interwoven to form the cell or cells. The fabric may have a single layer weight of less than 300 g/sq m, such as a weight of 175 g/sq m.

Preferably when the inflatable element is inflated the pressure of gas is approximately 3 bar. Preferably the inflatable element, when inflated, extends past the B-post of the vehicle, to provide protection for the head of the driver. If the head of the driver should impact with the B-post in an accident the consequences could be fatal.

In one embodiment the inflatable element incorporates a strap to connect part of the inflatable element to the door frame. The strap is tight, that is, tensioned to a significant extent, when the inflatable element is inflated.

Separate means may be provided to apply tension to part of the inflatable element when it is inflated, such as a piston and cylinder, adapted to be moved by gas from a gas generator when the inflatable element is inflated, to apply tension to one edge of the inflatable element, to hold the inflated element in a desired position.

In one embodiment the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain the means in the further position. Thus a slider may be provided adapted to slide along a ratchet, and to be retained by the ratchet when it has moved to a further position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which

FIG. 1 is a side view of the interior of a motor vehicle illustrating a safety device in accordance with the invention in an operative state,

FIG. 2 is a side view of part of the interior of a motor vehicle illustrating another safety device in accordance with the invention in the operative state,

FIG. 3 is a sectional view of part of the embodiment of FIG. 2 in a plane perpendicular to a longitudinal axis of the vehicle,

FIG. 4 is a view of part of FIG. 2 showing an additional component of the safety device,

FIG. 5 is a side view of the interior of a motor vehicle provided with another form of safety device in accordance with the invention, before the safety device moves to the operative state,

FIG. 6 illustrates the vehicle of FIG. 5 when the safety device is in the operative state,

FIG. 7 is a sectional view of one form of safety device as shown in FIG. 1 or in FIGS. 5 and 6 in a plane perpendicular to the vertical direction,

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FIG. 8 is a sectional view of another form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, and

FIG. 9 is a view of part of an alternative inflatable element for use in the embodiments of FIGS. 1, 5 and 6.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 1 a safety device is illustrated which is intended to provide protection for a person 1 sitting in a seat 2 in the vehicle. In any accident in which the vehicle is decelerated the person will tend to move forwardly towards the steering wheel 3, but will be restrained by a conventional seat belt or air-bag. In the case of a side impact or roll-over, there is a risk that the head of the person 1 will strike the window in the door beside the person, or strike the B-post. There is also a risk that if, as most commonly happens, the glass in the window should break, the head of the person 1 may be thrown out of the window, especially in the case of roll-over.

The safety device shown in the operative state in FIG. 1 is initially retained in a recess provided in the door frame 4 located above the door of the vehicle. The recess extends over more than simply a linear portion of the door frame so that the two ends of the recess are not in alignment with the main part of the recess.

The safety device comprises a gas generator 5, which is adapted to generate gas, such as cold gas. The gas generator incorporates, or is associated with, a sensor which senses a side impact and/or a roll-over situation to activate the gas generator at an appropriate instant. The gas generator is connected by a hose 6 to a duct 7. The duct 7 forms part of an inflatable element. The inflatable element incorporates a plurality of parallel substantially vertical, substantially cylindrical cells 8. The inflatable element may be made of interwoven fabric. Such a fabric comprises a first layer that defines the front of the inflatable element—that is to say the part that is visible in FIG. 1—and a second layer that defines the back part—that is to say the part that is adjacent the window in FIG. 1—selected parts of the first region and the second region being interwoven to define links in the form of points or lines where the front part and the back part of the inflatable element are secured together. A technique for making an inflatable element of inter-woven fabric is described in more detail in International Patent Publication WO90/09295.

A webbing strap 9 that forms part of the inflatable element extends from the end of the inflatable element near the duct 7 which is connected to the hose 6 to an anchoring point 10 on the door frame 4. The edge of the duct 7 between the points 11, adjacent the top of the B-post 12, and 13, at the lower part of the A-post, in the region of the dashboard 14, is fixed securely to the door frame 4. Consequently, it is to be understood that the upper edge of the inflatable element has a non-linear configuration which conforms with the non-linear configuration of the upper part of the door frame 4 by virtue of the inflatable element being secured, at an upper edge portion thereof, to the door frame all along a non-linear part of the door frame as shown in the figures. A substantial part, in fact virtually all, of the upper edge of the inflatable element is secured to the upper part of the door frame.

When an accident such as side impact occurs the gas generator generates cold gas which passes through the hose 6 to the duct 7, and then inflates the cells 8. The inflatable element thus moves from its initial stored position within the recess in the door frame to the operative position shown in

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FIG. 1. The inflatable element then extends downwardly from the top of the door frame to form a flat structure located between the head of the person 1 and the adjacent window. As the cylindrical cells inflate the length of the lower edge 15 of the inflatable element is reduced, and thus the lower edge, together with the webbing strap 9 extend substantially tightly from the point 10 to, the point 13. It is to be noted that the part of the door frame 4 between the points 10 and 13 is not linear, and defines, with the linear lower edge of the inflated element, a triangular area which is covered by the inflated element.

The lower edge of the inflated element decreases by about 10% between the uninflated state and the inflated state. The inflated element is fully inflated within about 15 ms. The total thickness of the inflated element, when inflated is approximately 30–40 mm. The seams of interweaving of the front part and the back part of the inflated element are approximately 30–40 mm apart, so that the resultant cells are cylindrical when inflated. The total volume of gas within the inflated element may be between 7 and 9 liters, and the gas may be at a pressure of about 3 bar. While the inflated element is not provided with a vent to vent gas from within the element to the atmosphere, so that the inflated element, when inflated, remains inflated for a long period of time—to provide protection in the case of a protracted roll-over—there is venting between at least selected adjacent cells 8, to avoid any severe rebound. Thus if the head of the person in the vehicle impacts with the inflated element the pressure of gas within the whole element, or at least a substantial part of the element will rise, thus giving a “soft” impact. If each cell were sealed with no venting of this type, there would be a risk of severe rebound.

The weight of the fabric should be kept to be as low as possible, so that if the inflatable element should impact with the head of the person in the vehicle as the inflatable element is inflated no harm will be done. It is thought that a material having a weight of less than 300 g/sq m, such as 175 g/sq m may be used.

It is to be noted that part of the inflated element extends rearwardly beyond the point 11, and is thus located between the head of the person 1 and the top of the B-post. Thus the risk of the head of the person impacting with the B-post is minimized. Since the upper edge of the inflatable element is secured to the upper part of the door frame along substantially the whole of its length, there is virtually no risk that the head of the occupant will pass between the upper edge of the inflatable element and the upper part of the door frame, with the head of the occupant of the vehicle thus inadvertently emerging from the body shell of the vehicle.

FIGS. 2 to 4 illustrate a second embodiment of the invention. In this embodiment an inflatable element 20 is provided which is initially stored in a recess provided in the door frame 21 of a motor vehicle. A gas generator 22 is provided, which again incorporates or is associated with a sensor or detector which activates the gas generator at an appropriate time. The gas generator is connected by a duct 23 to an inflatable part 24 of the inflatable element 20. The gas generator 22 is located in the door-frame 21 of the vehicle, but alternatively could be positioned in the B-post.

The inflatable part 24 or the inflatable section of the inflatable element 20 is formed from two layers of fabric, as in the embodiment of FIG. 1, with the front layer and the back layer of the fabric being woven together at selected points 25. The selected points 25 are arranged in vertically extending columns and serve to divide the inflatable part 24 into a plurality of vertical parallel chambers. The spaces

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between the selected points 25 permit internal venting between adjacent chambers.

The inflatable part 24 of the inflatable element 20 is adapted to be located adjacent the head of an occupant of the motor vehicle, and, towards the rear of the inflatable element, when in the position illustrated in FIG. 2, the inflatable part of the inflatable element extends from the top to the bottom of the inflatable element in a rear region and subsequently, the upper edge of the inflatable part extends downwardly towards the lower edge of the inflatable element, in a sense directed towards the A-Post 26. The remaining part or non-inflatable section of the inflatable element comprises a web or sheet 27 which extends from the inflatable parts 24 to the part of the door-frame 21 above the door and to the A-post. The web or sheet 27 is thus secured to parts of the door frame that are non-linear. It is to be appreciated, therefore, that in this embodiment of the invention the upper edge of the inflatable element is of non-linear form and is of the same configuration as the non-linear part of the door frame which extends forwardly from the B-post and which incorporates the A-post. The upper edge of the inflatable element, or at least a substantial part of that upper edge, is securely fixed to the upper part of the door frame, thus again minimizing any risk of the head of the occupant emerging from the body shell between the upper edge of the inflatable element and the upper part of the door frame.

Referring to FIG. 3 the edge of the sheet 27 that is secured to the door frame 21 may terminate with a bead 28 that is received within a slot 29 formed in the door frame, the mouth of the slot being narrower than the base so that the bead 28 can slide axially within the slot, but cannot escape from the slot. A cable 30 is connected to the end of the bead, as can be seen in FIG. 4, the cable being connected to a tensioning device 31. The tensioning device may comprise a piston in a cylinder associated with a gas generator to generate gas which moves the piston within the cylinder to apply tension to the cable 30 and thus to the bead 28. A ratchet or the like may hold the piston in place when it has been moved by the gas. The gas generator that supplies gas to the piston may be the gas generator 22 or may be a separate gas generator that is triggered simultaneously with the main gas generator.

When an accident occurs the inflatable element 20 moves from its stored position to the operative position shown in FIG. 2, and tension is applied to the inflatable element 20 by the distention of the inflatable part 24, and by the tension applied to the bead 28. The inflated element 20 is thus held firmly in position to provide protection for the head of the person sitting in the motor vehicle. The thickness of the element 20 and the weight of the material used should be as described with reference to the embodiment of FIG. 1.

FIGS. 5 and 6 illustrate another embodiment of the invention intended to provide protection not only for a person in the front seat of a motor vehicle such as a motor car, but also for a person in the rear seat of the vehicle.

Referring to FIG. 5, a recess 40 is provided in the doorframe 41 of a motor vehicle, the recess extending over both the front door 42 and the rear door 43. The recess extends from a point 44 located near the lower end of the A-post to a point 45 located near the lower end of the C-post.

A channel 46 is provided on the B-post, extending vertically. In the channel 46 is a ratchet R, and received within the upper end of the channel 46 is a ratchet engaging slide member 47. The slide member 47 is connected to a tab 48 which forms part of an inflatable element 49 see (FIG. 6), which is initially stored within the recess 40.

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The inflatable element 49 is shown in the inflated state in FIG. 6. The inflatable element has its top edge 50 secured to the part of the door frame 41 that extends above the doors 42, 43 of the motor vehicle. The top edge of the inflatable element is of non-linear configuration, and has a configuration which corresponds with the non-linear configuration of the upper part of the door frame. The design of the inflatable element is similar to that shown in FIG. 1, with the inflatable element presenting a plurality of parallel cells, which when inflated are substantially cylindrical. The structure of the inflatable element 49 may be the same as that described with reference to FIG. 1.

A gas generator 51 is provided which is connected to the inflatable element in such a way that when the gas generator is activated by a sensor that is formed integrally with the gas generator, or which is associated with the gas generator, and which responds to a side impact or to a roll-over situation to activate the gas generator, gas is initially supplied to the cells 52, 53, which are aligned with the tab 48. Thus initially, as the inflatable element 49 inflates, the cells 52 and 53 inflate and move the ratchet engaging slide member 47 downwardly. The ratchet engaging slide member thus moves down the slot 46 to the position shown in FIG. 6. The ratchet engaging slide member 47 engages the ratchet, and thus holds the tab 48 in its lower position.

The rest of the cells 54 of the inflatable element are then inflated, and the inflatable element then extends fully across the upper parts of the windows in the doors 42, 43 of the motor vehicle. It can be seen that the lower edge of the inflated element 49 extends between the points 44 and 45 at the ends of the recess 40. As the inflatable element 49 inflates, so the length of the lower edge thereof decreases as a consequence of the inflation of the cells of the inflatable element. This reduction in the length of the lower edge, together with the action of the ratchet engaging slide member 47 ensures that the inflated element is retained in position as illustrated after it has been inflated.

FIG. 7 is a cross section showing the nature of the cells of the inflated element of FIG. 1 and of FIGS. 5 and 6. It can be seen that the cells are immediately adjacent to each other and are only separated by narrow regions where the fabric forming the front part of the inflated element has been woven with the fabric forming the back part of the inflated element. However, FIG. 8 illustrates an alternative possibility, in which the regions of fabric between the cells that are woven together are relatively wide, the cells thus being separated by webs of fabric. The advantage of this latter possibility is that a smaller volume of gas may be required to fully inflate the inflatable elements, meaning that the inflatable element may be inflated more rapidly.

FIG. 9 illustrates an alternative form of inflatable element comprising a plurality of cells 60 or inflatable section. The upper edge of the inflatable element is of non-linear form and is connected to the non-linear portion of the door frame above the door. The configuration of the upper edge of the inflatable element and the configuration of the door frame correspond. It can be seen that each cell 60 is of substantially conical form, the cells being arranged adjacent each other and being parallel with each other. Between the cells are inverted triangular portions 61 or non-inflatable sections where the fabric forming the cells is interwoven.

When cells of this type are inflated, the length of the lower edge of the arrangement contracts, whereas the length of the upper edge of the arrangement remains constant.

An arrangement of this type can be used, therefore, to ensure that the lower edge of the element, when inflated, is under some tension.

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Whilst in the arrangement illustrated in FIG. 9, the cells are immediately adjacent each other, it is to be appreciated that a similar effect may be achieved if the cells are spaced apart. It is possible to replace at least part of the inverted triangular region 61 with further conical cells of an inverted orientation. 5

Whilst in the described embodiments of the invention, the inflatable element has been described as being made utilising a technique in which two layers of fabric are interwoven to define points or lines where the front layer and the rear layer are interwoven, it would be possible to form embodiments of the invention utilising two discrete layers of fabric which are interconnected by stitching. 10

What is claimed is:

1. A safety device in a motor vehicle having a door frame and front and rear doors contained within the door frame, the safety device comprising: 15

a gas generator;

a sensor associated with said gas generator for sensing one of a side impact and a roll-over and activating said gas generator; and 20

an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element being made of fabric and comprising: 25

a first layer to define a front part of said inflatable element;

a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected to define points where the front part and the back part of said inflatable element are secured together forming elongated cells; and 30

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an upper edge portion secured at selected points to a non-linear part of the door frame which extends over both the front door and the rear door, whereby, when inflated, said inflatable element is positioned adjacent the doors contained in the door frame.

2. A safety device according to claim 1, wherein the selected parts of the first fabric layer and the second fabric layer are interconnected in a plurality of predetermined areas for defining a plurality of links, the elongated cells being defined between the links, each cell defining a longitudinal axis, the cells being positioned so that the longitudinal axes of the cells extend generally transversely to a lower edge of the inflatable element such that, upon inflation of the inflatable element with gas from the gas generator, the length of the lower edge of the inflatable element is reduced. 15

3. A safety device according to claim 2, wherein the inflatable element is made of interwoven fabric layers, said links being constituted by selected parts of the first layer and selected parts of the second layer, with the selected parts of the first layer and the second layer being interwoven.

4. A safety device according to claim 2, wherein the axes of the cells are substantially parallel.

5. A safety device according to claim 1, wherein the cells are configured to be in gas flow communication with one another.

6. A safety device according to claim 1, wherein the cells are immediately adjacent each other.

7. A safety device according to claim 1, wherein the cells are spaced apart from each other.

8. A safety device according to claim 1, wherein at least some of the cells are of conical form when inflated.

* * * * *

Exhibit F

(12) **United States Patent**
Håland et al.

(10) **Patent No.: US 6,402,192 B2**
(45) **Date of Patent: *Jun. 11, 2002**

(54) **SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR**

5,333,899 A 8/1994 Witte

5,588,672 A 12/1996 Karlow et al.

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(73) Assignee: **Autoliv Development AB**, Vargarda (SE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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Primary Examiner—Peter English

(74) Attorney, Agent, or Firm—Venable; Robert Kinberg; Catherine M. Voorhees

(21) Appl. No.: **09/949,943**

(22) Filed: **Sep. 12, 2001**

Related U.S. Application Data

(63) Continuation of application No. 09/589,402, filed on Jun. 8, 2000, now Pat. No. 6,312,009, which is a continuation of application No. 09/127,918, filed on Aug. 3, 1998, now Pat. No. 6,099,029, which is a continuation of application No. 08/604,052, filed on Feb. 20, 1996, now Pat. No. 5,788,270.

(30) **Foreign Application Priority Data**

Feb. 20, 1995 (GB) 9503267

(51) **Int. Cl.**⁷ **B60R 21/22**; B60R 21/24

(52) **U.S. Cl.** **280/729**; 280/730.2

(58) **Field of Search** 280/730.2, 730.1, 280/729, 743.1, 743.2, 728.1, 753, 749

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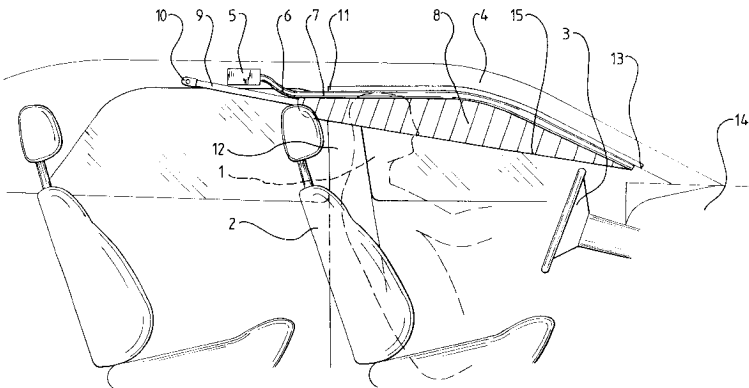
4,227,717 A 10/1980 Bouvier

5,322,322 A 6/1994 Bark et al.

(57) **ABSTRACT**

A safety device for a motor vehicle which has a door frame and a door contained within the door frame includes: a gas generator; a sensor for sensing at least one of a side impact and a roll-over for activating the gas generator; and an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator. The inflatable element can thus assume a non-inflated mode and an inflated mode and can further be positioned adjacent the door in an inflated-mode thereof. The inflatable element is further made of fabric and includes: a first fabric layer defining a front part thereof; a second fabric layer defining a back part thereof, selected parts of the first fabric layer and second fabric layer being interconnected for defining one of linear and point shaped links where the first fabric layer and the second fabric layer are directly secured together. The inflatable element thus incorporates a plurality of substantially parallel elongated cells defined between the links, the cells being configured such that, upon inflation of the inflatable element with the gas from the gas generator, a lower edge portion of the inflatable element is tensioned. The inflatable element further includes an upper edge portion which is configured to be secured to the door frame all along a non-linear part of the door frame.

22 Claims, 5 Drawing Sheets



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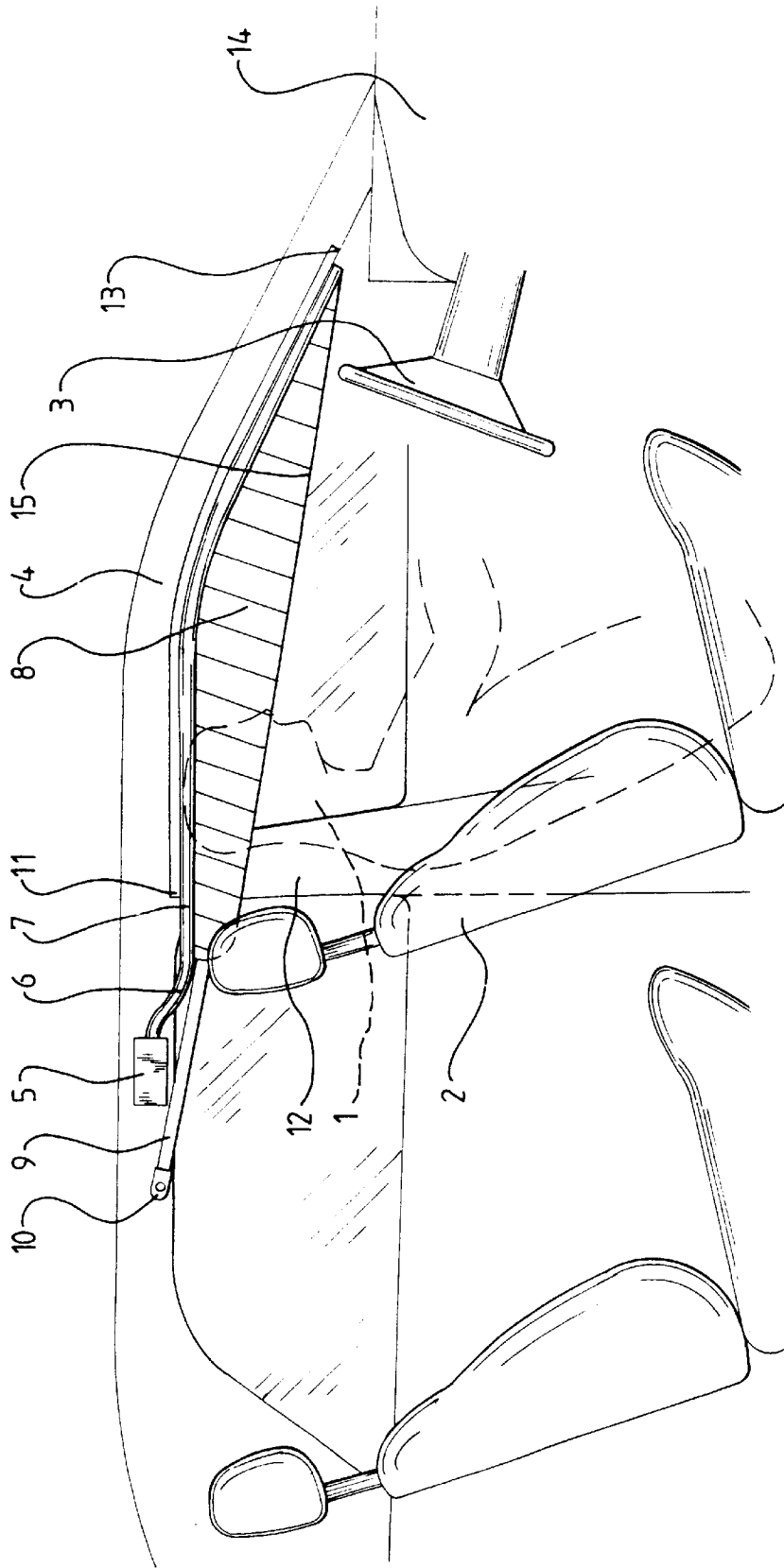


FIG 1

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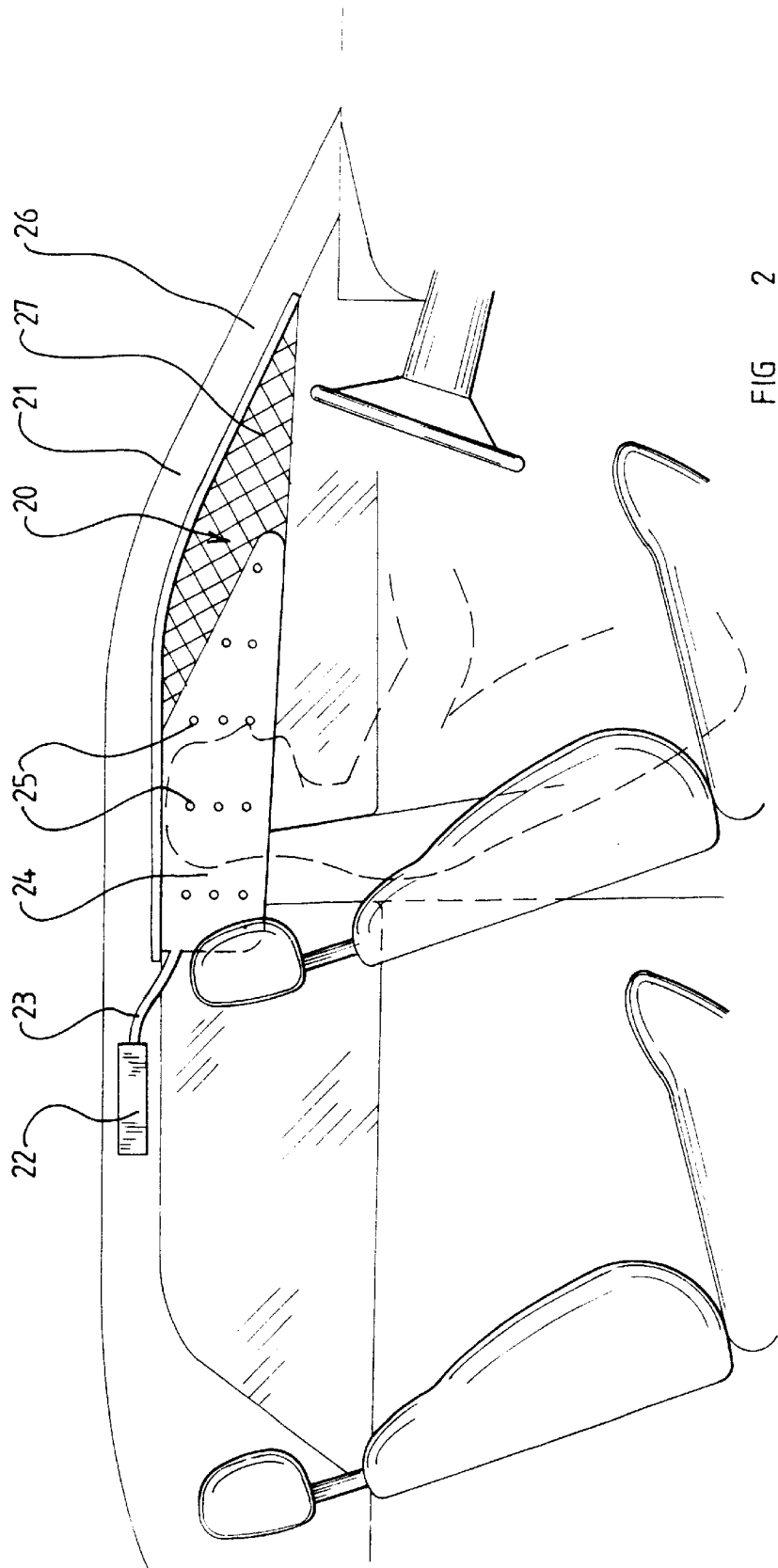


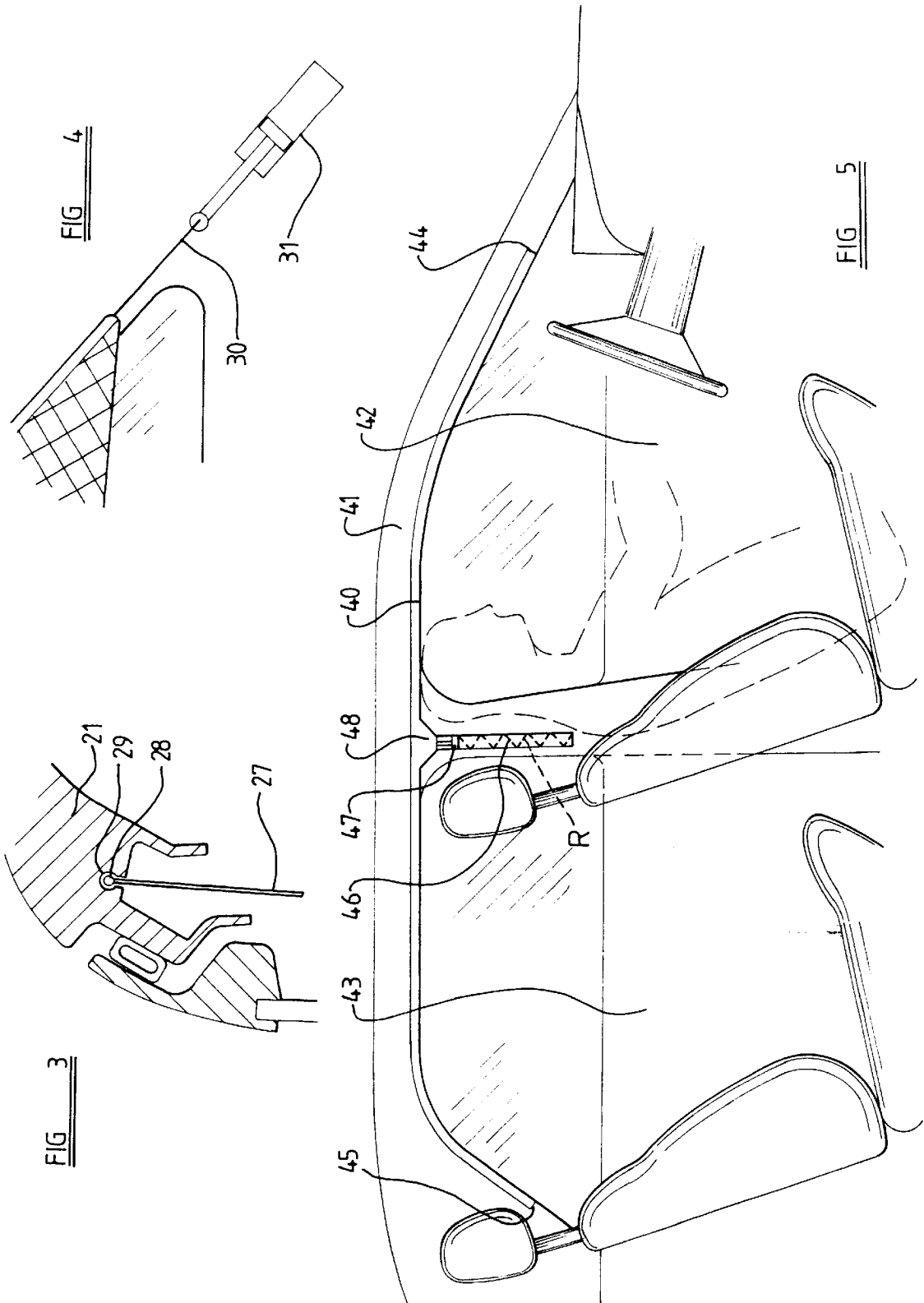
FIG. 2

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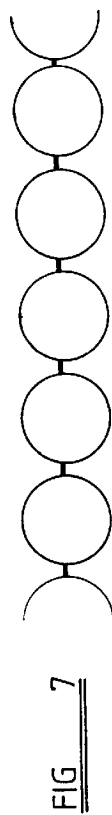
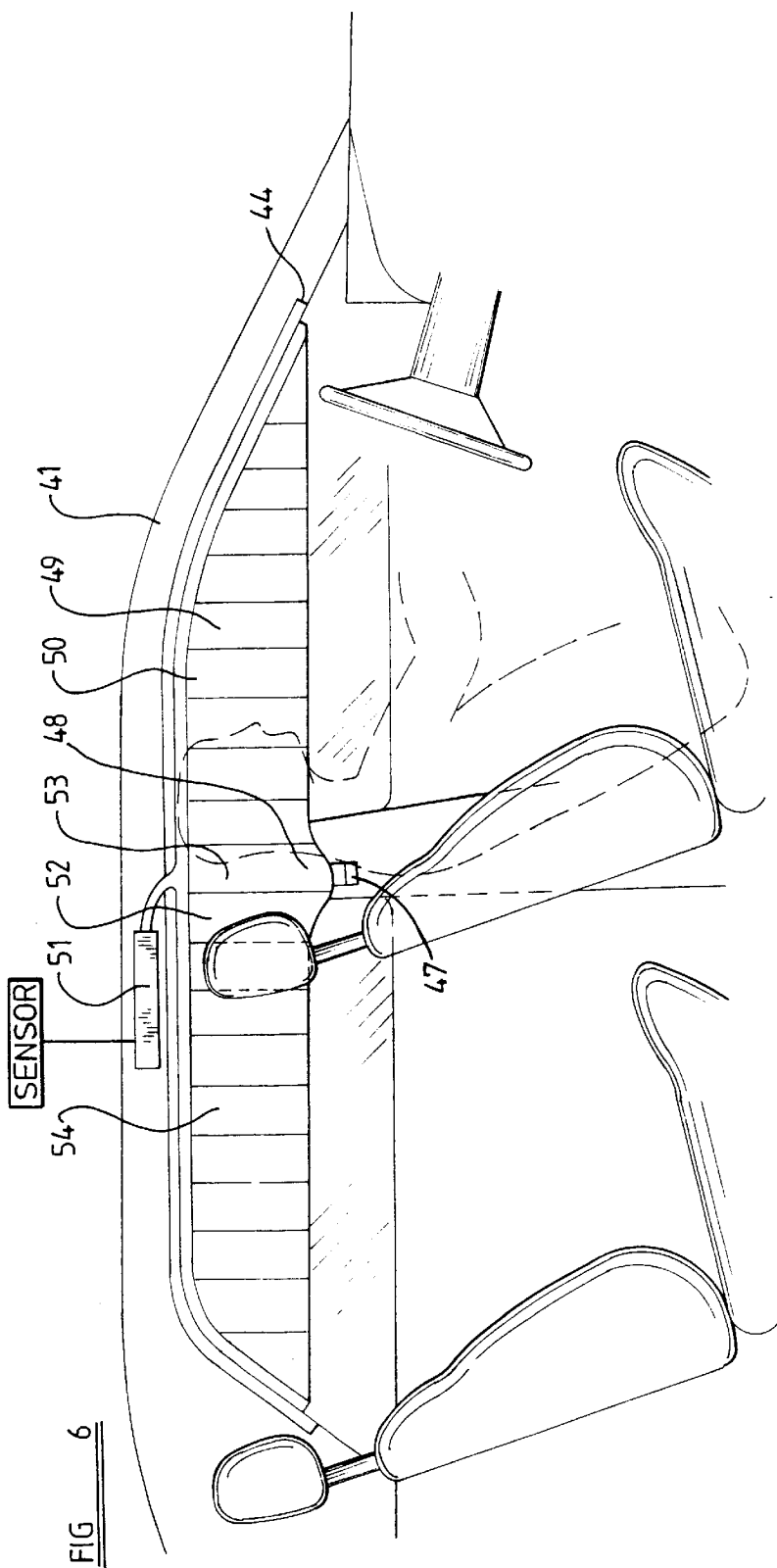


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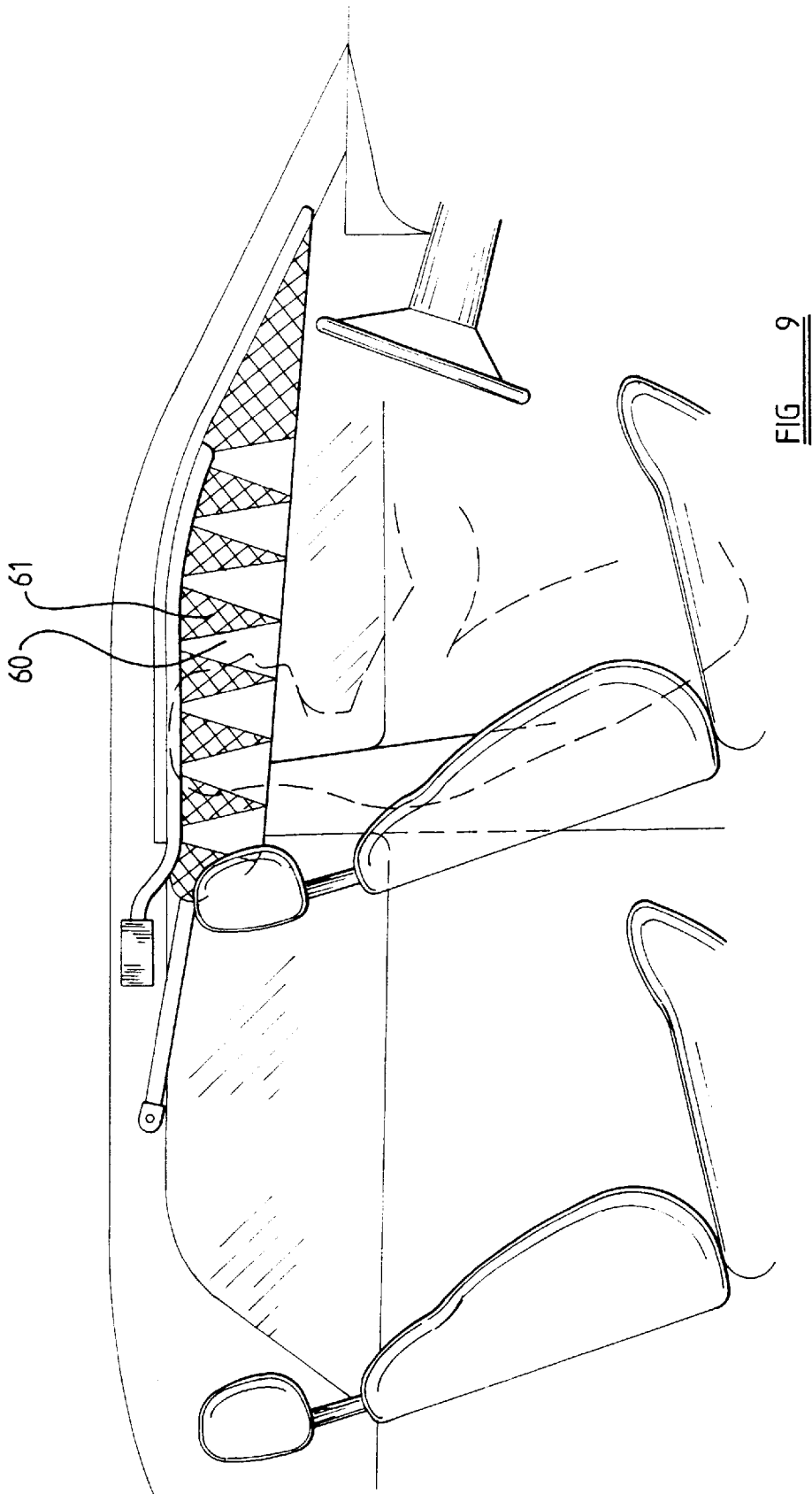


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SIDE IMPACT AND ROLL OVER INFLATABLE HEAD PROTECTOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 09/589,402 filed Jun. 8, 2000, now, U.S. Pat. No. 6,312,009 which is a continuation of U.S. application Ser. No. 09/127, 918, filed Aug. 3, 1998, now U.S. Pat. No. 6,099,029 which is a continuation of U.S. application Ser. No. 08/604,052, filed Feb. 20, 1996, now U.S. Pat. No. 5,788,270.

FIELD OF THE INVENTION

THIS INVENTION relates to a safety device, and more particularly relates to a safety device in a motor vehicle such as a motor car.

BACKGROUND OF THE INVENTION

When a motor vehicle is involved in an accident there is a risk that the driver and passengers within the vehicle will be injured. It has been proposed to provide vehicles with safety devices to reduce the risk of such injury.

Certain safety devices are intended to provide protection in the case of a side impact. U.S. Pat. No. 5,322,322 discloses such a device. An inflatable tube is initially stored in a recess in the door frame above the door of the vehicle, and the ends of the tube are pivotally anchored to fixed points on the door frame. A sensor is provided to sense when an accident occurs, and to initiate inflation of the tube. As the tube inflates its length decreases, and it then extends linearly between the two fixed points on the door frame. The inflated tube provides some protection for the head of a person sitting in the vehicle. However, the tube is inflated to a substantial pressure, and thus the head of a person in the vehicle may tend to bounce off the tube. The tube may not cover the whole of the area of the window, and may not even cover the whole of the upper part of the window. There is thus a risk that the head of the person in the vehicle may move past the tube and pass through the window opening. If a car is rolling over this is very undesirable.

SUMMARY OF THE INVENTION

This invention seeks to provide an improved safety device.

According to this invention there is provided a safety device in a motor vehicle, the device comprising a gas generator, incorporating or associated with a sensor adapted to sense a side-impact or a roll-over and to activate the gas generator, and an inflatable element connected to the gas generator to be inflated by gas from the gas generator, the inflatable element being made of fabric comprising a first layer to define the front part of the inflatable element, and a second layer to define the back part of the inflatable element, selected parts of the first layer and the second layer being interconnected to define points or lines where the front part and back part of the inflatable element are secured together, the inflatable element incorporating a plurality of substantially parallel elongate cells, the inflatable element having an edge portion secured to part of the door frame of the vehicle, which is non-linear, the inflatable element, when inflated, being positioned adjacent the door contained within the door frame.

The inflatable element, when inflated, is thus located between the head of a person sitting in the vehicle and an

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adjacent door. Usually such a door is provided with a window and so the inflated element provides protection from breaking glass from the window, and also prevents the head of the person in the vehicle from striking the window, or from being thrown out through the window, as can happen, particularly with roll-over accidents.

Preferably the safety device is usually initially stored in a recess provided in the doorframe.

Preferably the inflatable element is made of interwoven fabric layers, the selected parts of the first layer and the second layer being interwoven. Preferably there is internal venting between the cells as this may reduce undesirable bounce that might occur if the cells were discrete and not vented to each other.

The cells may be immediately adjacent each other or may be spaced apart. At least some of the cells may be of conical form when inflated.

The inflatable element may be formed of a fabric with parts of the fabric being interwoven to form the cell or cells. The fabric may have a single layer weight of less than 300 g/sq m, such as a weight of 175 g/sq m.

Preferably when the inflatable element is inflated the pressure of gas is approximately 3 bar. Preferably the inflatable element, when inflated, extends past the B-post of the vehicle, to provide protection for the head of the driver. If the head of the driver should impact with the B-post in an accident the consequences could be fatal.

In one embodiment the inflatable element incorporates a strap to connect part of the inflatable element to the door frame. The strap is tight, that is, tensioned to a significant extent, when the inflatable element is inflated.

Separate means may be provided to apply tension to part of the inflatable element when it is inflated, such as a piston and cylinder, adapted to be moved by gas from a gas generator when the inflatable element is inflated, to apply tension to one edge of the inflatable element, to hold the inflated element in a desired position.

In one embodiment the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain the means in the further position. Thus, a slider may be provided adapted to slide along a ratchet, and to be retained by the ratchet when it has moved to a further position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings in which

FIG. 1 is a side view of the interior of a motor vehicle illustrating a safety device in accordance with the invention in an operative state,

FIG. 2 is a side view of part of the interior of a motor vehicle illustrating another safety device in accordance with the invention in the operative state,

FIG. 3 is a sectional view of part of the embodiment of FIG. 2, in a plane perpendicular to a longitudinal axis of the vehicle.

FIG. 4 is a view of part of FIG. 2 showing an additional component of the safety device,

FIG. 5 is a side view of the interior of a motor vehicle provided with another form of safety device in accordance with the invention, before the safety device moves to the operative state,

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FIG. 6 illustrates the vehicle of FIG. 5 when the safety device is in the operative state,

FIG. 7 is a sectional view of one form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, in a plane perpendicular to the vertical direction.

FIG. 8 is a sectional view of another form of safety device as shown in FIG. 1 or in FIGS. 5 and 6, and

FIG. 9 is a view of part of an alternative inflatable element for use in the embodiments of FIGS. 1, 5 and 6.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 1 a safety device is illustrated which is intended to provide protection for a person 1 sitting in a seat 2 in the vehicle. In any accident in which the vehicle is decelerated the person will tend to move forwardly towards the steering wheel 3, but will be restrained by a conventional seat belt or air-bag. In the case of a side impact or roll-over, there is a risk that the head of the person 1 will strike the window in the door beside the person, or strike the B-post. There is also a risk that if, as most commonly happens, the glass in the window should break, the head of the person 1 may be thrown out of the window, especially in the case of roll-over.

The safety device shown in the operative state in FIG. 1 is initially retained in a recess provided in the door frame 4 located above the door of the vehicle. The recess extends over more than simply a linear portion of the door frame so that the two ends of the recess are not in alignment with the main part of the recess.

The safety device comprises a gas generator 5, which is adapted to generate gas, such as cold gas. The gas generator incorporates, or is associated with, a sensor which senses a side impact and/or a roll-over situation to activate the gas generator at an appropriate instant. The gas generator is connected by a hose 6 to a duct 7. The duct 7 forms part of an inflatable element. The inflatable element incorporates a plurality of parallel substantially vertical, substantially cylindrical cells 8. The inflatable element may be made of interwoven fabric. Such a fabric comprises a first layer that defines the front of the inflatable element—that is to say the part that is visible in FIG. 1—and a second layer that defines the back part—that is to say the part that is adjacent the window in FIG. 1—selected parts of the first region and the second region being interwoven to define links in the form of points or lines where the front part and the back part of the inflatable element are secured together. A technique for making an inflatable element of interwoven fabric is described in more detail in International Patent Publication WO 90/09295.

A webbing strap 9 that forms part of the inflatable element extends from the end of the inflatable element near the duct 7 which is connected to the hose 6 to an anchoring point 10 on the door frame 4. The edge of the duct 7 between the points 11, adjacent the top of the B-post 12, and 13, at the lower part of the A-post, in the region of the dashboard 14, is fixed securely to the door frame 4. Consequently, it is to be understood that the upper edge of the inflatable element has a non-linear configuration which conforms with the non-linear configuration of the upper part of the door frame 4 by virtue of the inflatable element being secured, at an upper edge portion thereof, to the door frame all along a non-linear part of the door frame as shown in the figures. A substantial part, in fact virtually all, of the upper edge of the inflatable element is secured to the upper part of the door frame.

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When an accident such as side impact occurs the gas generator generates cold gas which passes through the hose 6 to the duct 7, and then inflates the cells 8. The inflatable element thus moves from its initial stored position within the recess in the door frame to the operative position shown in FIG. 1. The inflatable element then extends downwardly from the top of the door frame to form a flat structure located between the head of the person 1 and the adjacent window. As the cylindrical cells inflate the length of the lower edge 15 of the inflatable element is reduced, and thus the lower edge, together with the webbing strap 9 extend substantially tightly from the point 10 to the point 13. It is to be noted that the part of the door frame 4 between the points 10 and 13 is not linear, and defines, with the linear lower edge of the inflated element, a triangular area which is covered by the inflated element.

The lower edge of the inflated element decreases by about 10% between the uninflated state and the inflated state. The inflated element is fully inflated within about 15 ms. The total thickness of the inflated element, when inflated is approximately 30–40 mm. The seams of interweaving of the front part and the back part of the inflated element are approximately 30–40 mm apart, so that the resultant cells are cylindrical when inflated. The total volume of gas within the inflated element may be between 7 and 9 liters, and the gas may be at a pressure of about 3 bar. While the inflated element is not provided with a vent to vent gas from within the element to the atmosphere, so that the inflated element, when inflated, remains inflated for a long period of time—to provide protection in the case of a protracted roll-over—there is venting between at least selected adjacent cells 8, to avoid any severe rebound. Thus if the head of the person in the vehicle impacts with the inflated element the pressure of gas within the whole element, or at least a substantial part at the element will rise, thus giving a “soft” impact. If each cell were sealed with no venting of this type, there would be a risk of severe rebound.

The weight of the fabric should be kept to be as low as possible, so that if the inflatable element should impact with the head of the person in the vehicle as the inflatable element is inflated no harm will be done. It is thought that a material having a weight of less than 300 g/sq m, such as 175 g/sq m may be used.

It is to be noted that part of the inflated element extends rearwardly beyond the point 11, and is thus located between the head of the person 1 and the top of the B-post. Thus, the risk of the head of the person impacting with the B-post is minimized. Since the upper edge of the inflatable element is secured to the upper part of the door frame along substantially the whole of its length, there is virtually no risk that the head of the occupant will pass between the upper edge of the inflatable element and the upper part of the door frame, with the head of the occupant of the vehicle thus inadvertently emerging from the body shell of the vehicle.

FIGS. 2 to 4 illustrate a second embodiment of the invention. In this embodiment, an inflatable element 20 is provided which is initially stored in a recess provided in the door frame 21 of a motor vehicle. A gas generator 22 is provided, which again incorporates or is associated with a sensor or detector which activates the gas generator at an appropriate time. The gas generator is connected by a duct 23 to an inflatable part 24 of the inflatable element 20. The gas generator 22 is located in the door frame 21 of the vehicle, but alternatively could be positioned in the B-post.

The inflatable part 24 or the inflatable section of the inflatable element 20 is formed from two layers of fabric, as

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in the embodiment of FIG. 1, with the front layer and the back layer of the fabric being woven together at selected points 25. The selected points 25 are arranged in vertically extending columns and serve to divide the inflatable part 24 into a plurality of vertical parallel chambers. The spaces between the selected points 25 permit internal venting between adjacent chambers.

The inflatable part 24 of the inflatable element 20 is adapted to be located adjacent the head of an occupant of the motor vehicle, and, towards the rear of the inflatable element, when in the position illustrated in FIG. 2, the inflatable part of the inflatable element extends from the top to the bottom of the inflatable element in a rear region and subsequently, the upper edge of the inflatable part extends downwardly towards the lower edge of the inflatable element, in a sense directed towards the A-Post 26. The remaining part or non-inflatable section of the inflatable element comprises a web or sheet 27 which extends from the inflatable part 24 to the part of the door frame 21 above the door and to the A-post. The web or sheet 27 is thus secured to parts of the door frame that are non-linear. It is to be appreciated, therefore, that in this embodiment of the invention the upper edge of the inflatable element is of non-linear form and is of the same configuration as the non-linear part of the door frame which extends forwardly from the B-post and which incorporates the A-post. The upper edge of the inflatable element, or at least a substantial part of the upper edge, is securely fixed to the upper part of the door frame, thus again minimizing any risk of the head of the occupant emerging from the body shell between the upper edge of the inflatable element and the upper part of the door frame.

Referring to FIG. 3 the edge of the sheet 27 that is secured to the door frame 21 may terminate with a bead 28 that is received within a slot 29 formed in the door frame, the mouth of the slot being narrower than the base so that the bead 28 can slide axially within the slot, but cannot escape from the slot. A cable 30 is connected to the end of the bead, as can be seen in FIG. 4, the cable being connected to a tensioning device 31. The tensioning device may comprise a piston in a cylinder associated with a gas generator to generate gas which moves the piston within the cylinder to apply tension to the cable 30 and thus to the bead 28. A ratchet or the like may hold the piston in place when it has been moved by the gas. The gas generator that supplies gas to the piston may be the gas generator 22 or may be a separate gas generator that is triggered simultaneously with the main gas generator.

When an accident occurs, the inflatable element 20 moves from its stored position to the operative position shown in FIG. 2, and tension is applied to the inflatable element 20 by the distention of the inflatable part 24, and by the tension applied to the bead 28. The inflated element 20 is thus held firmly in position to provide protection for the head of the person sitting in the motor vehicle. The thickness of the element 20 and the weight of the material used should be as described with reference to the embodiment of FIG. 1.

FIGS. 5 and 6 illustrate another embodiment of the invention intended to provide protection not only for a person in the front seat of a motor vehicle such as a motor car, but also for a person in the rear seat of the vehicle.

Referring to FIG. 5, a recess 40 is provided in the doorframe 41 of a motor vehicle, the recess extending over both the front door 42 and the rear door 43. The recess extends from a point 44 located near the lower end of the A-post to a point 45 located near the lower end of the C-post.

A channel 46 is provided on the B-post, extending vertically. In the channel 46 is a ratchet R, and received within

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the upper end of the channel 46 is a ratchet engaging slide member 47. The slide member 47 is connected to a tab 48 which forms part of an inflatable element 49 (see FIG. 6), which is initially stored within the recess 40.

The inflatable element 49 is shown in the inflated state in FIG. 6. The inflatable element has its top edge 50 secured to the part of the door frame 41 that extends above the doors 42, 43 of the motor vehicle. The top edge of the inflatable element is of non-linear configuration, and has a configuration which corresponds with the non-linear configuration of the upper part of the door frame. The design of the inflatable element is similar to that shown in FIG. 1, with the inflatable element presenting a plurality of parallel cells, which when inflated are substantially cylindrical. The structure of the inflatable element 49 may be the same as that described with reference to FIG. 1.

A gas generator 51 is provided which is connected to the inflatable element in such a way that when the gas generator is activated by a sensor that is formed integrally with the gas generator, or which is associated with the gas generator, and which responds to a side impact or to a roll-over situation to activate the gas generator, gas is initially supplied to the cells 52, 53, which are aligned with the tab 48. Thus initially, as the inflatable element 49 inflates, the cells 52 and 53 inflate and move the ratchet engaging slide member 47 downwardly. The ratchet engaging slide member thus moves down the slot 46 to the position shown in FIG. 6. The ratchet engaging slide member 47 engages the ratchet, and thus holds the tab 48 in its lower position.

The rest of the cells 54 of the inflatable element are then inflated, and the inflatable element then extends fully across the upper parts of the windows in the doors 42, 43 of the motor vehicle. It can be seen that the lower edge of the inflated element 49 extends between the points 44 and 45 at the ends of the recess 40. As the inflatable element 49 inflates, so the length of the lower edge thereof decreases as a consequence of the inflation of the cells of the inflatable element. This reduction in the length of the lower edge, together with the action of the ratchet engaging slide member 47 ensures that the inflated element is retained in position as illustrated after it has been inflated.

FIG. 7 is a cross section showing the nature of the cells of the inflated element of FIG. 1 and of FIGS. 5 and 6. It can be seen that the cells are immediately adjacent to each other and are only separated by narrow regions where the fabric forming the front part of the inflated element has been woven with the fabric forming the back part of the inflated element. However, FIG. 8 illustrates an alternative possibility, in which the regions of fabric between the cells that are woven together are relatively wide, the cells thus being separated by webs of fabric. The advantage of this latter possibility is that a smaller volume of gas may be required to fully inflate the inflatable element, meaning that the inflatable element may be inflated more rapidly.

FIG. 9 illustrates an alternative form of inflatable element comprising a plurality of cells 60 or inflatable sections. The upper edge of the inflatable element is of non-linear form and is connected to the non-linear portion of the door frame above the door. The configuration of the upper edge of the inflatable element and the configuration of the door frame correspond. It can be seen that each cell 60 is of substantially conical form, the cells being arranged adjacent each other and being parallel with each other. Between the cells are inverted triangular portions 61 or non-inflatable sections where the fabric forming the cells is interwoven.

When cells of this type are inflated, the length of the lower edge of the arrangement contracts, whereas the length of the upper edge of the arrangement remains constant.

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An arrangement of this type can be used, therefore, to ensure that the lower edge of the element, when inflated, is under some tension.

Whilst in the arrangement illustrated in FIG. 9, the cells are immediately adjacent each other, it is to be appreciated that a similar effect may be achieved if the cells are spaced apart. It is possible to replace at least part of the inverted triangular region 61 with further conical cells of an inverted orientation.

While in the described embodiments of the invention, the inflatable element has been described as being made utilising a technique in which two layers of fabric are interwoven to define points or lines where the front layer and the rear layer are interwoven, it would be possible to form embodiments of the invention utilising two discrete layers of fabric which are interconnected by stitching.

What is claimed is:

1. A safety device for a motor vehicle having a door frame, the safety device comprising:

a gas generator;

a sensor operatively connected to said gas generator for sensing at least one of a side impact and a roll-over that activates said gas generator; and

an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element comprising:

a first layer to define a front part of said inflatable element;

a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected in a plurality of predetermined areas to define regions where the front part and the back part of said inflatable element are secured together forming elongated cells, and where an upper edge portion of the inflatable element is adapted to be secured to at least one anchoring point on the door frame at a level above a door contained within the door frame; and

an extension piece extending from a predetermined area and adapted to be secured to a second anchoring point on the vehicle, whereby, the cells of the inflatable element are configured such that, upon inflation of said inflatable element, the length of the part of said inflatable element between the anchoring point on the door frame and the second anchoring point on the vehicle is reduced so that this part of the inflatable element, together with the extension piece, is tensioned.

2. A safety device according to claim 1, wherein said inflatable element is made of fabric.

3. A safety device according to claim 1, wherein the regions defined by the interconnection of the first and second layers form linear links.

4. A safety device according to claim 1, wherein the regions defined by the interconnection of the first and second layers form point-shaped links.

5. A safety device according to claim 1, wherein the extension piece is a strap.

6. A safety device according to claim 1, wherein the extension piece is a web.

7. A safety device according to claim 1, wherein the extension piece is a sheet.

8. A safety device according to claim 1, wherein the inflatable element is initially stored in a recess provided in the door frame.

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9. A safety device according to claim 1, wherein there is internal venting between the cells.

10. A safety device according to claim 1, wherein the cells are immediately adjacent to one another.

11. A safety device according to claim 1, wherein the cells are spaced from each other.

12. A safety device according to claim 1, wherein at least some of the cells are of conical form when inflated.

13. A safety device according to claim 1, wherein the motor vehicle has a B-post and the inflatable element, when inflated, extends past the B-post of the vehicle.

14. A safety device according to claim 1, wherein the inflatable element is provided with means adapted to move from an initial position to a further position on inflation of the inflatable element, an arrangement being provided to retain said means in said further position.

15. A safety device according to claim 1, wherein axes of the cells are substantially parallel.

16. A safety device according to claim 1, wherein said elongated cells are substantially vertical.

17. A safety device mounted in a motor vehicle having an A-post, a door frame, a door contained within the door frame, and a B-post, the safety device comprising:

a gas generator;

a sensor operatively connected to the gas generator for sensing at least one of a side impact and a roll-over for activating the gas generator; and

an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator, the inflatable element having an inflatable section adapted to be positioned adjacent the door and a non-inflatable section, the inflatable element comprising:

a first layer defining a front part thereof;

a second layer defining a back part thereof, selected parts of the first layer and the second layer being interconnected in a plurality of predetermined areas defining a plurality of links between which elongated cells for inflation are defined;

an upper edge portion secured to the door frame at a level above the door at at least one anchoring point; and

an extension piece extending from a predetermined area and adapted to be secured to a point on the A-post of the vehicle, whereby, the cells of the inflatable section of the inflatable element are configured such that, upon inflation of said inflatable element, the length of the part of said inflatable element between the anchoring point on the door frame and said point on the A-post of the vehicle is reduced so that this part of the inflatable element, together with the extension piece, is tensioned.

18. A safety device according to claim 17, wherein said inflatable element is made of fabric.

19. A safety device according to claim 17, wherein said elongated cells are substantially vertical.

20. A safety device installed in a motor vehicle having a door frame, the safety device comprising:

a gas generator;

a sensor operatively connected to said gas generator for sensing at least one of a side impact and a roll-over that activates said gas generator; and

an inflatable element connected to said gas generator to be inflated by gas from said gas generator upon activation of said gas generator, said inflatable element comprising:

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a first layer to define a front part of said inflatable element;
a second layer to define a back part of said inflatable element, with selected parts of the first layer and the second layer being interconnected in a plurality of predetermined areas to form elongated cells, where
at least an upper edge portion of the inflatable element is secured to the door frame at a level above a door contained within the door frame; and
an extension piece extending from a predetermined area and secured to an anchoring point on the vehicle, whereby, the cells of the inflatable element are configured such that, upon inflation of said inflatable element, the length of the part of said inflatable element between said anchoring point on the vehicle and another point where the inflatable element is connected to the vehicle is reduced so that this part of the inflatable element, together with the extension piece, is tensioned.

21. A safety device according to claim 20, wherein the inflatable element has a lower edge having a first end and a second end, the first end of the lower edge being constituted by part of the extension piece, and wherein said another point is located at the second end of the lower edge.

22. A safety device mounted in a motor vehicle having an A-post, a door frame, a door contained within the door frame, and a B-post, the safety device comprising:

- a gas generator;
- a sensor operatively connected to the gas generator for sensing at least one of a side impact and a roll-over for activating the gas generator; and

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an inflatable element connected to the gas generator for being inflated with gas from the gas generator upon activation of the gas generator, the inflatable element having an inflatable section adapted to be positioned adjacent the door and a non-inflatable section, the inflatable element comprising:

- a first layer defining a front part thereof;
- a second layer defining a back part thereof, selected parts of the first layer and the second layer being interconnected in a plurality of predetermined areas defining a plurality of links between which elongated cells for inflation are defined;

an upper edge portion secured to the door frame at a level above the door, where a part of the inflatable element is secured to the vehicle at a point behind the B-post; and

an extension piece extending from a predetermined area and adapted to be secured to a point on the A-post of the vehicle, whereby, the cells of the inflatable section of the inflatable element are configured such that, upon inflation of said inflatable element, the length of the part of said inflatable element between the secured point behind the B-post and said point on the A-post of the vehicle is reduced so that this part of the inflatable element, together with the extension piece, is tensioned.

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